

GLOBAL JOURNAL

OF SCIENCE FRONTIER RESEARCH: C

Biological Science

Soil Microbial Diversity

Biosphere Reserve Forest

Highlights

Important Fatty Acids

Photosynthesis of Soybean

Discovering Thoughts, Inventing Future

VOLUME 13

ISSUE 3

VERSION 1.0



GLOBAL JOURNAL OF SCIENCE FRONTIER RESEARCH: C
BIOLOGICAL SCIENCE

GLOBAL JOURNAL OF SCIENCE FRONTIER RESEARCH: C
BIOLOGICAL SCIENCE

VOLUME 13 ISSUE 3 (VER. 1.0)

OPEN ASSOCIATION OF RESEARCH SOCIETY

© Global Journal of Science
Frontier Research .2013.

All rights reserved.

This is a special issue published in version 1.0
of "Global Journal of Science Frontier
Research." By Global Journals Inc.

All articles are open access articles distributed
under "Global Journal of Science Frontier
Research"

Reading License, which permits restricted use.
Entire contents are copyright by of "Global
Journal of Science Frontier Research" unless
otherwise noted on specific articles.

No part of this publication may be reproduced
or transmitted in any form or by any means,
electronic or mechanical, including
photocopy, recording, or any information
storage and retrieval system, without written
permission.

The opinions and statements made in this
book are those of the authors concerned.
Ultraculture has not verified and neither
confirms nor denies any of the foregoing and
no warranty or fitness is implied.

Engage with the contents herein at your own
risk.

The use of this journal, and the terms and
conditions for our providing information, is
governed by our Disclaimer, Terms and
Conditions and Privacy Policy given on our
website [http://globaljournals.us/terms-and-condition/
menu-1463/](http://globaljournals.us/terms-and-condition/menu-1463/)

By referring / using / reading / any type of
association / referencing this journal, this
signifies and you acknowledge that you have
read them and that you accept and will be
bound by the terms thereof.

All information, journals, this journal,
activities undertaken, materials, services and
our website, terms and conditions, privacy
policy, and this journal is subject to change
anytime without any prior notice.

Incorporation No.: 0423089
License No.: 42125/022010/1186
Registration No.: 430374
Import-Export Code: 1109007027
Employer Identification Number (EIN):
USA Tax ID: 98-0673427

Global Journals Inc.

(A Delaware USA Incorporation with "Good Standing"; **Reg. Number: 0423089**)

Sponsors: *Open Association of Research Society*
Open Scientific Standards

Publisher's Headquarters office

Global Journals Inc., Headquarters Corporate Office,
Cambridge Office Center, II Canal Park, Floor No.
5th, **Cambridge (Massachusetts)**, Pin: MA 02141
United States

USA Toll Free: +001-888-839-7392

USA Toll Free Fax: +001-888-839-7392

Offset Typesetting

Open Association of Research Society, Marsh Road,
Rainham, Essex, London RM13 8EU
United Kingdom.

Packaging & Continental Dispatching

Global Journals, India

Find a correspondence nodal officer near you

To find nodal officer of your country, please
email us at local@globaljournals.org

eContacts

Press Inquiries: press@globaljournals.org

Investor Inquiries: investers@globaljournals.org

Technical Support: technology@globaljournals.org

Media & Releases: media@globaljournals.org

Pricing (Including by Air Parcel Charges):

For Authors:

22 USD (B/W) & 50 USD (Color)

Yearly Subscription (Personal & Institutional):

200 USD (B/W) & 250 USD (Color)

EDITORIAL BOARD MEMBERS (HON.)

John A. Hamilton, "Drew" Jr.,
Ph.D., Professor, Management
Computer Science and Software
Engineering
Director, Information Assurance
Laboratory
Auburn University

Dr. Henry Hexmoor
IEEE senior member since 2004
Ph.D. Computer Science, University at
Buffalo
Department of Computer Science
Southern Illinois University at Carbondale

Dr. Osman Balci, Professor
Department of Computer Science
Virginia Tech, Virginia University
Ph.D. and M.S. Syracuse University,
Syracuse, New York
M.S. and B.S. Bogazici University,
Istanbul, Turkey

Yogita Bajpai
M.Sc. (Computer Science), FICCT
U.S.A. Email:
yogita@computerresearch.org

Dr. T. David A. Forbes
Associate Professor and Range
Nutritionist
Ph.D. Edinburgh University - Animal
Nutrition
M.S. Aberdeen University - Animal
Nutrition
B.A. University of Dublin- Zoology

Dr. Wenying Feng
Professor, Department of Computing &
Information Systems
Department of Mathematics
Trent University, Peterborough,
ON Canada K9J 7B8

Dr. Thomas Wischgoll
Computer Science and Engineering,
Wright State University, Dayton, Ohio
B.S., M.S., Ph.D.
(University of Kaiserslautern)

Dr. Abdurrahman Arslanyilmaz
Computer Science & Information Systems
Department
Youngstown State University
Ph.D., Texas A&M University
University of Missouri, Columbia
Gazi University, Turkey

Dr. Xiaohong He
Professor of International Business
University of Quinnipiac
BS, Jilin Institute of Technology; MA, MS,
PhD,. (University of Texas-Dallas)

Burcin Becerik-Gerber
University of Southern California
Ph.D. in Civil Engineering
DDes from Harvard University
M.S. from University of California, Berkeley
& Istanbul University

Dr. Bart Lambrecht

Director of Research in Accounting and Finance
Professor of Finance
Lancaster University Management School
BA (Antwerp); MPhil, MA, PhD
(Cambridge)

Dr. Carlos García Pont

Associate Professor of Marketing
IESE Business School, University of Navarra
Doctor of Philosophy (Management),
Massachusetts Institute of Technology (MIT)
Master in Business Administration, IESE,
University of Navarra
Degree in Industrial Engineering,
Universitat Politècnica de Catalunya

Dr. Fotini Labropulu

Mathematics - Luther College
University of Regina
Ph.D., M.Sc. in Mathematics
B.A. (Honors) in Mathematics
University of Windsor

Dr. Lynn Lim

Reader in Business and Marketing
Roehampton University, London
BCom, PGDip, MBA (Distinction), PhD,
FHEA

Dr. Mihaly Mezei

ASSOCIATE PROFESSOR
Department of Structural and Chemical
Biology, Mount Sinai School of Medical
Center
Ph.D., Eötvös Loránd University
Postdoctoral Training,
New York University

Dr. Söhnke M. Bartram

Department of Accounting and Finance
Lancaster University Management School
Ph.D. (WHU Koblenz)
MBA/BBA (University of Saarbrücken)

Dr. Miguel Angel Ariño

Professor of Decision Sciences
IESE Business School
Barcelona, Spain (Universidad de Navarra)
CEIBS (China Europe International Business School).
Beijing, Shanghai and Shenzhen
Ph.D. in Mathematics
University of Barcelona
BA in Mathematics (Licenciatura)
University of Barcelona

Philip G. Moscoso

Technology and Operations Management
IESE Business School, University of Navarra
Ph.D in Industrial Engineering and
Management, ETH Zurich
M.Sc. in Chemical Engineering, ETH Zurich

Dr. Sanjay Dixit, M.D.

Director, EP Laboratories, Philadelphia VA
Medical Center
Cardiovascular Medicine - Cardiac
Arrhythmia
Univ of Penn School of Medicine

Dr. Han-Xiang Deng

MD., Ph.D
Associate Professor and Research
Department Division of Neuromuscular
Medicine
Davee Department of Neurology and Clinical
Neuroscience
Northwestern University
Feinberg School of Medicine

Dr. Pina C. Sanelli

Associate Professor of Public Health
Weill Cornell Medical College
Associate Attending Radiologist
NewYork-Presbyterian Hospital
MRI, MRA, CT, and CTA
Neuroradiology and Diagnostic
Radiology
M.D., State University of New York at
Buffalo, School of Medicine and
Biomedical Sciences

Dr. Roberto Sanchez

Associate Professor
Department of Structural and Chemical
Biology
Mount Sinai School of Medicine
Ph.D., The Rockefeller University

Dr. Wen-Yih Sun

Professor of Earth and Atmospheric
SciencesPurdue University Director
National Center for Typhoon and
Flooding Research, Taiwan
University Chair Professor
Department of Atmospheric Sciences,
National Central University, Chung-Li,
TaiwanUniversity Chair Professor
Institute of Environmental Engineering,
National Chiao Tung University, Hsin-
chu, Taiwan.Ph.D., MS The University of
Chicago, Geophysical Sciences
BS National Taiwan University,
Atmospheric Sciences
Associate Professor of Radiology

Dr. Michael R. Rudnick

M.D., FACP
Associate Professor of Medicine
Chief, Renal Electrolyte and
Hypertension Division (PMC)
Penn Medicine, University of
Pennsylvania
Presbyterian Medical Center,
Philadelphia
Nephrology and Internal Medicine
Certified by the American Board of
Internal Medicine

Dr. Bassey Benjamin Esu

B.Sc. Marketing; MBA Marketing; Ph.D
Marketing
Lecturer, Department of Marketing,
University of Calabar
Tourism Consultant, Cross River State
Tourism Development Department
Co-ordinator , Sustainable Tourism
Initiative, Calabar, Nigeria

Dr. Aziz M. Barbar, Ph.D.

IEEE Senior Member
Chairperson, Department of Computer
Science
AUST - American University of Science &
Technology
Alfred Naccash Avenue – Ashrafieh

PRESIDENT EDITOR (HON.)

Dr. George Perry, (Neuroscientist)

Dean and Professor, College of Sciences

Denham Harman Research Award (American Aging Association)

ISI Highly Cited Researcher, Iberoamerican Molecular Biology Organization

AAAS Fellow, Correspondent Member of Spanish Royal Academy of Sciences

University of Texas at San Antonio

Postdoctoral Fellow (Department of Cell Biology)

Baylor College of Medicine

Houston, Texas, United States

CHIEF AUTHOR (HON.)

Dr. R.K. Dixit

M.Sc., Ph.D., FICCT

Chief Author, India

Email: authorind@computerresearch.org

DEAN & EDITOR-IN-CHIEF (HON.)

Vivek Dubey(HON.)

MS (Industrial Engineering),

MS (Mechanical Engineering)

University of Wisconsin, FICCT

Editor-in-Chief, USA

editorusa@computerresearch.org

Sangita Dixit

M.Sc., FICCT

Dean & Chancellor (Asia Pacific)

deanind@computerresearch.org

Suyash Dixit

(B.E., Computer Science Engineering), FICCTT

President, Web Administration and

Development , CEO at IOSRD

COO at GAOR & OSS

Er. Suyog Dixit

(M. Tech), BE (HONS. in CSE), FICCT

SAP Certified Consultant

CEO at IOSRD, GAOR & OSS

Technical Dean, Global Journals Inc. (US)

Website: www.suyogdixit.com

Email: suyog@suyogdixit.com

Pritesh Rajvaidya

(MS) Computer Science Department

California State University

BE (Computer Science), FICCT

Technical Dean, USA

Email: pritesht@computerresearch.org

Luis Galárraga

J!Research Project Leader

Saarbrücken, Germany

CONTENTS OF THE VOLUME

- i. Copyright Notice
 - ii. Editorial Board Members
 - iii. Chief Author and Dean
 - iv. Table of Contents
 - v. From the Chief Editor's Desk
 - vi. Research and Review Papers
-
- 1. Two New Black Mildews from Western Ghats of Peninsular India. **1-2**
 - 2. Influence of K^+ , Na^+ and HCO_3^- on Photosynthesis of Soybean Seedlings. **3-6**
 - 3. Soil Microbial Diversity of Dibru-Saikhowa Biosphere Reserve Forest of Assam, India. **7-13**
 - 4. Antifungal Activities of Essential Oils and Crude Extracts of Some Aromatic Plants against *Fusarium* Rot of *Trichosanthes Dioica*. **15-20**
 - 5. Domestic Pig Organs as Good Sources of Nutritionally Important Fatty Acids and Low Cholesterol Meat. **21-37**
-
- vii. Auxiliary Memberships
 - viii. Process of Submission of Research Paper
 - ix. Preferred Author Guidelines
 - x. Index



GLOBAL JOURNAL OF SCIENCE FRONTIER RESEARCH
BIOLOGICAL SCIENCE

Volume 13 Issue 3 Version 1.0 Year 2013

Type : Double Blind Peer Reviewed International Research Journal

Publisher: Global Journals Inc. (USA)

Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Two New Black Mildews from Western Ghats of Peninsular India

By V.B. Hosagoudar & A. Sabeena

Jawaharlal Nehru Tropical Botanic Garden and Research Institute, Kerala, India

Abstract - This note gives an account of two new species of black colony forming fungi, namely, *Meliola scleropyricola* and *Prillieuxina memecylonis* collected on *Scleropyrum penta-ndrum* and *Memecylon umbellatum*, respectively, and are one each from Kerala and Karnataka States. Both these species are described and illustrated in detail.

Keywords : india, new species, meliola, asterina, kerala, Karnataka.

GJSFR-C Classification : FOR Code: 060799



Strictly as per the compliance and regulations of :



Two New Black Mildews from Western Ghats of Peninsular India

V.B. Hosagoudar^a & A. Sabeena^σ

Abstract - This note gives an account of two new species of black colony forming fungi, namely, *Meliola scleropyricola* and *Prillieuxina memecylonis* collected on *Scleropyrum pentandrum* and *Memecylon umbellatum*, respectively, and are one each from Kerala and Karnataka States. Both these species are described and illustrated in detail.

Keywords : india, new species, meliola, asterina, kerala, Karnataka.

I. DESCRIPTION OF SPECIES

a) *Meliola Scleropyricola*

V.B. Hosagoudar and A. Sabeena **sp.nov.**

(Fig.1)

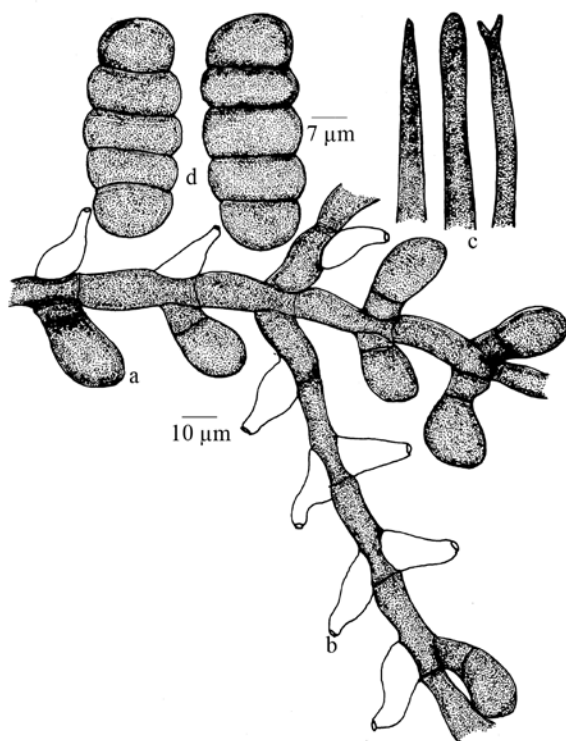


Figure 1 : *Meliola Scleropyricola*

a. Appressorium, b. Phialide, C. Apical portion of mycelia setae, d. Ascospores.

Colonies amphigenous, subdense to dense, velvety, up to 4 mm in diam., confluent. Hyphae substraight to flexuous, branching opposite to unilateral at acute to wide angles, loosely to closely

reticulate, cells 17-30 × 7-10 μm. Appressoria alternate, up to 5% opposite, rarely unilateral, antrorse, subantrorse to retrorse, straight to curved, 20-30 μm long; stalk cells cylindrical to cuneate, 5-12 μm long; head cells broadly ovate, globose, oblong, entire, 15-17 × 10-15 μm. Phialides mixed with appressoria, opposite, ampulliform, 15-22 × 5-12 μm. Mycelial setae simple, straight, obtuse to dentate at the tip, up to 950 μm long. Perithecia scattered, up to 150 μm in diam.; ascospores cylindrical to oblong, 4-septate, constricted at the septa, 47-57 × 17-22 μm.

b) Material Examined

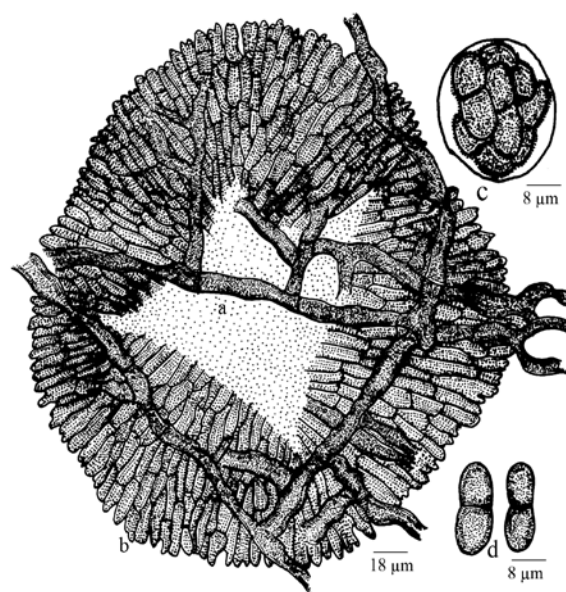
On leaves of *Scleropyrum pentandrum* (Dennst) Mabb. (Santalaceae), November 23, 2012, Jawaharlal Nehru Tropical Botanic Garden & Research Institute, Palode, Thiruvananthapuram, Kerala, A. Sabeena & al TBGT 6592 (holotype).

Meliola scleropyri is the only known species on this host from the Southern Western Ghats (Hosagoudar, 1996). However, *Meliola scleropyricola* differs from it in having 5% opposite appressoria and having notably larger ascospores (47-57 × 17-22 vs 32-36 × 11-12).

c) *Prillieuxina Memecylonis*

V.B. Hosagoudar and A. Sabeena, **sp. nov.**

(Fig. 2)



Prillieuxina Memecylonis

a. Mycelium, b. Thyriothecium, c. Ascus, d. Ascospores

Author α σ : Jawaharlal Nehru Tropical Botanic Garden and Research Institute, Palode 695 562, Thiruvananthapuram, Kerala, India.

E-mail : vbhosagoudar@rediffmail.com

Colonies hypophyllous, subdense, up to 3 mm in diameter, confluent. Hyphae flexuous to crooked, branching irregular at acute to wide angles, loosely to closely reticulate, cells 25-42 x 3-5 µm. Appressoria absent. Thyriothecia scattered, orbicular, up to 250 µm in diameter, stellately dehiscent at the centre; asci globose, octosporous, up to 20 µm in diameter; ascospores conglobate, oblong, 1-septate, constricted at the septum, 17-20 × 7-10 µm, wall smooth. Pycnothyria similar to thyriothecia; pycnothyriospores ovate, globose, unicellular, 12-17 × 7-10 µm.

d) *Materialexamined*

On leaves of *Memecylon umbellatum* Burm.f. (Melastomataceae), Madikeri, Kodagu, Karnataka, December 31, 2002, V.B. Hosagoudar TBGT 6593 (holotype).

This is the first species of the genus *Prillieuxina* on this host genus (Stevens, & Ryan, 1939).

ACKNOWLEDGEMENTS

We thank Dr. P.G. Latha, Director, JNTBGRI, Palode for the facilities.

REFERENCES RÉFÉRENCES REFERENCIAS

1. Hosagoudar, V.B. 1996. *Meliolales of India*. Botanical Survey of India, Calcutta, pp. 363.
2. Stevens, F.L. and Ryan, M.H. 1939. The Microthyriaceae. *Illinois Biological Monographs* 17: 1-138.



Influence of K^+ , Na^+ and HCO_3^- on Photosynthesis of Soybean Seedlings

By Jianjun Hao, Chunhua Huang, Huan Lu & Yang Yu

Shenyang Agricultural University

Abstract - In this study, Tiefeng 31 seedling leaves were sprayed with 1500 mg L⁻¹ KHCO₃ and NaHCO₃, respectively, and determined the photosynthetic rate, soluble sugar, photosynthetic pigment and other physiological indexes to explore the effect of K^+ , Na^+ and HCO_3^- on soybean seedlings photosynthesis. The results showed that: compared with water spraying control, K^+ , Na^+ and HCO_3^- improved soybean seedlings photosynthetic rate, the content of soluble sugar, chlorophyll a, chlorophyll b, and the ratio of chlorophyll b in total chlorophyll; promoted soybean seedlings photosynthesis by providing more assimilatory power to dark reactions carbon fixation; and enhanced the activities of ATP enzyme, photo phosphorylation, and PEPC. In addition, HCO_3^- played a more important role in promoting chlorophyll b synthesis and improving photosynthetic rate. NaHCO₃ significantly increased the content of Rubisco. For other physiological indexes but the content of Rubisco, the promotion of K^+ is more than Na^+ .

Keywords : KHCO₃; NaHCO₃; soybean seedlings leaves; photosynthesis; rubisco.

GJSFR-C Classification : FOR Code: 820405



Strictly as per the compliance and regulations of :



Influence of K^+ , Na^+ and HCO_3^- on Photosynthesis of Soybean Seedlings

Jianjun Hao ^α, Chunhua Huang ^σ, Huan Lu ^ρ & Yang Yu ^ω

Abstract - In this study, Tiefeng 31 seedling leaves were sprayed with 1500 mg L⁻¹ KHCO₃ and NaHCO₃, respectively, and determined the photosynthetic rate, soluble sugar, photosynthetic pigment and other physiological indexes to explore the effect of K⁺, Na⁺ and HCO₃⁻ on soybean seedlings photosynthesis. The results showed that: compared with water spraying control, K⁺, Na⁺ and HCO₃⁻ improved soybean seedlings photosynthetic rate, the content of soluble sugar, chlorophyll a, chlorophyll b, and the ratio of chlorophyll b in total chlorophyll; promoted soybean seedlings photosynthesis by providing more assimilatory power to dark reactions carbon fixation; and enhanced the activities of ATP enzyme, photo phosphorylation, and PEPC. In addition, HCO₃⁻ played a more important role in promoting chlorophyll b synthesis and improving photosynthetic rate. NaHCO₃ significantly increased the content of Rubisco. For other physiological indexes but the content of Rubisco, the promotion of K⁺ is more than Na⁺.

Keywords : KHCO₃; NaHCO₃; soybean seedlings leaves; photosynthesis; rubisco.

I. INTRODUCTION

CO₂ is the raw material of photosynthesis, the optimal concentration of plant photosynthesis is about 1000 μ l/l, but the C3 plants need a concentration of 800μ l/l to 1600 μ l/l. The main source of carbon of Terrestrial plants are from the CO₂ in the air ; the CO₂ content is about 360 μ l/l in the air and it cannot meet the need of plant photosynthesis, so improve the CO₂ content will increase Plant photosynthesis rate obviously. Now the atmospheric CO₂ concentration is too high, has brought all kinds of destruction to the human environment. It is a subject of realistic meaning and theoretical significance, that how to increase the carbon sources scientifically and avoid the side effects to the environment. In recent years, a lot of reports in the literature use soybean (Han Wang, et al., 2008), rice (Liyang Zhang, et al., 2007) and cucumber (Yanan Xing, et al., 2006) seedlings as test materials, KHCO₃ is sprayed on the leaves of them and increased Plant photosynthesis rate. The test is based on the work of Han Wang et al. (2008), explore the influence of K⁺ and Na⁺ on soybean seedlings photosynthesis, Rubisco content, PEPC vigor and electronic transfer from ion level, and provide the theoretical bases for the application of KHCO₃ in soybean production.

Author α σ ρ ω : College of Biological Science and Technology, Shenyang Agricultural University, Shenyang 110866, Liaoning, China.
E-mail : haojianjun106@126.com

II. MATERIAL AND METHOD

a) Experiment Design

Experimental product is "Tie feng 31" soybean seedlings. Firstly clean the seeds, then soak seeds and evenly tiles them in big petri dishes (two layer of wet gauze are laid in the bottom and top), the sprout will be expedited in incubator having 30°C constant temperature. About two days later, choose seeds with the same length of bud, plant them in lymph plate which has many holes cultivate them in the artificial incubator. When the soybean seedlings grows to the first pair leaves expand, divide the seedling plate and transplant them into larger flowerpot, until the the second piece ternate leaves expand that can be used as experimental material.

The experiment has three treatments (act three times): No.1, clear water comparison treatment; No.2, 1500mg/L KHCO₃ water-soluble fluid treatment; No.3, 1500mg/L NaHCO₃ water-soluble fluid treatment. To spray on the leaves of the first and the second period of soybean separately with watering can (causing solution to form even and close distribution on leaf blade surface), when the second piece ternate leaves expand. Process-time is 4 PM around. Six days later, using the first and second piece ternate leaves as the experimental materials to mensurate photosynthetic physiology indexes. The KHCO₃ and NaHCO₃ both produced in shenyang chemical reagent factory.

b) Measuring Items and Method

Determine photosynthetic rate by Oxygen electrode. The equipment of dissolved oxygen is that domestic CY-II of measuring oxygen gauge as host, matched with reaction cup, magnetic mixer, the constant temperature water-bath water, automatic recorder, light source etc. Soluble sugar content refers to the methods of Xianzheng Zhang (1992), that Anthracene ketone method. Chlorophyll a (Chla), chlorophyll b (Chlb), chlorophyll total amount (Chl a + b) and carotenoids (CTK) use Arnon method. Photosynthetic electron transfer rate refers to the methods of Qilin Chen et al. (2000) and Chunmei Wang et al. (2000). ATP enzyme activity refers to the methods of HeshengLi (2000). Rubisco enzyme content is Determined by MaSiLiang LAN G-250 method. PEPC activity refers to the methods of Fusheng Feng et al. (1992) and Yonghua Dong et al. (1995).

c) *Data Analysis*

Using the Excel 2003 and SPSS 13.0 analyze data.

III. RESULT AND ANALYSIS

a) *Soluble Sugar Content*

From Figure 1, we can obtain that $KHCO_3$ treatment and $NaHCO_3$ treatment both increase the soluble sugar content of soybean seedlings. Among them, compared with CK, $KHCO_3$ treatment and $NaHCO_3$ treatment were increased by 74.65% and 38.03% respectively. It show that their joint HCO_3^- have increased the soluble sugar content, and the promoting function of K^+ is higher than Na^+ .

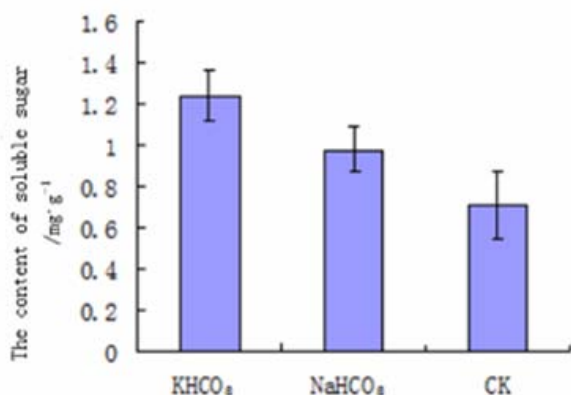


Figure 1 : Effects of Na^+ , K^+ and HCO_3^- on soluble sugar content of soybean seedlings leaves

b) *Photosynthetic Pigment Content*

From Figure 1, we can obtain that $KHCO_3$ treatment and $NaHCO_3$ treatment both increased the Chla, Chlb, Chl a + b and CTK content. Compared with CK, $KHCO_3$ treatment and $NaHCO_3$ treatment result in the Chla increased by 4.63% and 0.94%, the Chlb increased by 21.86% and 4.33%. It shows that the promoting function of K^+ is higher than Na^+ .

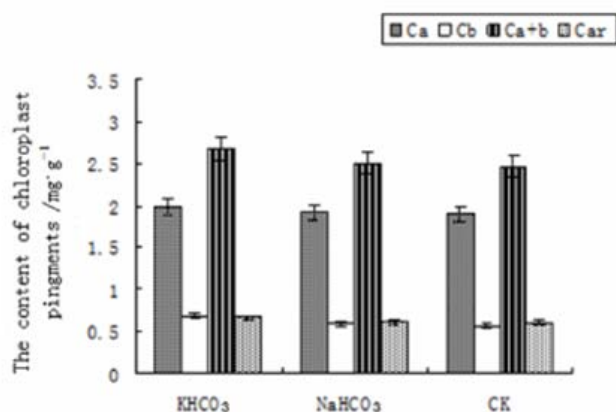


Figure 2 : Effects of Na^+ , K^+ and HCO_3^- on photosynthetic pigments content of soybean seedlings leaves

c) *Photosynthetic Electron Transport Rate*

From Figure 3, we can obtain that $KHCO_3$ treatment and $NaHCO_3$ treatment both increased photosynthetic electron transport rate of soybean seedlings from different degree. Compared with CK, $KHCO_3$ treatment and $NaHCO_3$ treatment were increased by 23.66% and 20.1% respectively. It show that their joint HCO_3^- have increased the photosynthetic electron transport rate and the promoting function of K^+ is higher than Na^+ .

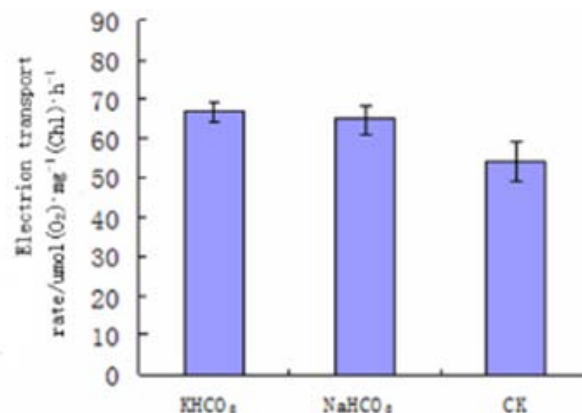


Figure 3 : Effect of Na^+ , K^+ and HCO_3^- on the electron transport rate of soybean seedlings leaves

d) *ATP-Enzyme Activity*

From Figure 4, we can obtain that $KHCO_3$ treatment and $NaHCO_3$ treatment both increased ATP-enzyme activity of soybean seedlings, it show that $KHCO_3$ and $NaHCO_3$ have the function of acceleration. The function of acceleration of $KHCO_3$ is more than $NaHCO_3$, it means that HCO_3^- is the main factor and the next is K^+ . In addition, $KHCO_3$ can increase the level of photophosphorylation, promote the photosynthetic electron transport.

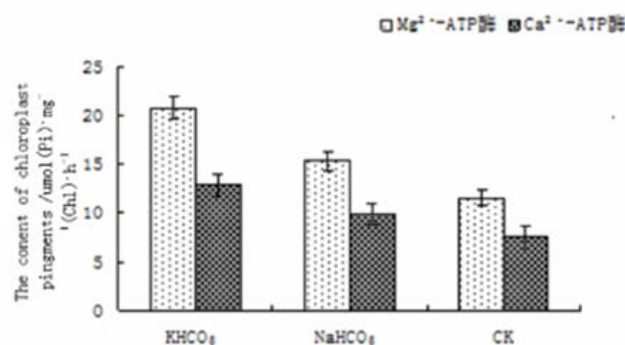


Figure 4 : Effects of Na^+ , K^+ and HCO_3^- on ATP-enzyme activity of soybean seedlings leaves

e) *Rubisco Content*

According to Table 1, compared with CK, $KHCO_3$ treatment made the Rubisco content decreased by 5.17% and $NaHCO_3$ treatment made the Rubisco content increased by 30.02%, it means that K^+ may have the inhibition to Rubisco biosynthesis. Compared

with CK, KHCO₃ treatment causes the Rubisco containing in the soluble protein to reduce 18.06%, and reduce 28.21% compared with NaHCO₃ treatment. From the above statement we can obtain that K⁺ can increase

the soluble protein, it has a effect on Rubisco biosynthesis but possibly increases other protein synthesis, decrease the Rubisco percentage in the soluble protein.

Table 1 : Effects of Na⁺, K⁺ and HCO₃⁻ on content of Rubisco of soybean seedlings leaves

Treatment	Rubisco content	Δ%	RubiscoOccupies soluble protein the percentage (%)	Δ%
KHCO ₃	5.9270±1.1030	-5.17	35.29	-18.06
NaHCO ₃	8.1260±2.2016*	30.02	49.16	14.14
CK	6.2500±1.1450	-----	43.07	-----

* means significant difference compared with CK ($P < 0.05$), the same below

f) PEPC-Enzyme Activity

According to Table 2, KHCO₃ treatment and NaHCO₃ treatment both increased PEPC-enzyme activity and PEPC-enzyme specific activity obviously. Compared with CK, the PEPC-enzyme activity increased by 45.60% and 36.99% respectively, the PEPC-enzyme

specific activity increased by 44.38% and 33.16% respectively. It means that their joint HCO₃⁻ have increased PEPC-enzyme activity and PEPC-enzyme specific activity obviously, and the promoting function of K⁺ is higher than Na⁺.

Table 2 : Effects of Na⁺, K⁺ and HCO₃⁻ on PEPC enzyme activities of soybean seedlings leaves

Treatment	Enzyme activity/nmol·mL ⁻¹ ·min ⁻¹	Increment/%	Enzyme specific activity/nmol·μg ⁻¹ ·min ⁻¹	Δ%
KHCO ₃	7.1200±1.0274*	45.60	5.3700±0.6588*	36.99
NaHCO ₃	7.0600±0.8326*	44.38	5.2200±0.8532*	33.16
CK	4.8900±0.9266	-----	3.9200±0.6285	-----

g) Photosynthetic Rate

According to Table 3, compared with CK, KHCO₃ treatment and NaHCO₃ treatment both increased photosynthetic rate. The acceleration of KHCO₃ treatment on soybean seedlings photosynthetic rate is the highest, it increased by 13.20% compared

with CK and 6.85% compared with NaHCO₃. It indicates that the promoting function of K⁺ is higher than Na⁺, their joint HCO₃⁻ plays the main role, HCO₃⁻ can promote the photosynthesis for that reason that as a carbon source in photosynthetic carbon cycle.

Table 3 : Effects of Na⁺, K⁺ and HCO₃⁻ on photosynthetic rate of the leaf of soybean seedlings

Treatment	photosynthetic rate/μmol·m ⁻² ·s ⁻¹	Δ%
KHCO ₃	9.5200±0.3233*	13.20
NaHCO ₃	8.9100±0.1386	5.95
CK	8.4100±0.1848	---

IV. CONCLUSION AND DISCUSSION

Potassium can promote chlorophyll biosynthesis effectively (Bingsong Zheng, 2002), KHCO₃ can also improve plant chlorophyll content (YingchangLi, et al., 2006). The study shows that, HCO₃⁻ and K⁺ both can improve the Chla, Chlb and Chl a + b content, and improve the primary reaction of photosynthesis. According to the research of Lihua Rao et al. (1989), it will reduce the speed of photosynthetic

product output, photosynthesis and lower yields, Damaged chloroplasts, when the potassium is excessive. This study did not appear this phenomenon, the reason maybe that the potassium is not excessive, that is to say the concentration of KHCO₃ is the optimal and reduce the damage of chloroplasts greatly.

According to the research of Bingsong Zheng (2006), spraying appropriate concentration of potassium can increase Chloroplast grana, photosynthetic electron transport, photophosphorylation, photosynthesis, acti-

vate the Rubisco activate enzymes, Rubisco activity. The study shows that, HCO_3^- and K^+ both can significantly improve soybean seedlings photosynthetic electron transport rate, ATP-enzyme activity, and speed up the process of the photophosphorylation.

According to the rearch of Camp et al. (1982), in the C_3 plants, PEPC added C_4 organic acid biosynthesis, It is a key enzyme of the "back to fill the metabolic" pathway, is the speed limit enzymes of C_4 microcirculation. The study shows that, soybean seedlings leaves contain PEPC, spraying $KHCO_3$ on the leaf increased soybean seedlings leaves PEPC-enzyme activity and PEPC-enzyme specific activity, the reason maybe that HCO_3^- can be used as the substrate of carboxylase PEP to promote its carboxy reaction, HCO_3^- and K^+ both can speed up the process of the photosynthetic dark reactions by by improving Rubisco activity, content and activity of PEPcase. K^+ affected Rubisco biosynthesis, increased its PEPC protein biosynthesis at the same time.

In this experiment, $KHCO_3$ treatment decreased Rubisco content, there are maybe some reasons : Rubisco content and air CO_2 are related. The air CO_2 density ascension causes the plant of Rubisco content reduce (Chen G-Y,2005; Spencer W, Bowes G,1986), this possibly is the adjustment of plant to Rubisco content in the process of adapting to external environment, so CO_2 assimilation and the electron transferring ability become balanced. In this experiment, HCO_3^- was spurted on the leaf, which increases CO_2 density indirectly, thus the Rubisco content dropped. In addition, K^+ possibly increases others protein biosynthesis while suppresses the Rubisco biosynthesis in the translation level.

In this experiment, Na^+ in the $NaHCO_3$ aqueous solution has little influence on soybean seedlings photosynthesis.

REFERENCES RÉFÉRENCES REFERENCIAS

1. Han Wang, Yang Yu, Jianjun Hao (2008). Influence of $KHCO_3$ and $NaHSO_3$ on photosynthesis rate of soybean seedling. *Soybean Sciences*, 27(3): 546-550.
2. Liying Zhang, Yang Yu, Jianjun Hao (2007). Influence of $KHCO_3$ on photosynthesis rate of rice seedling. *Journal of Anhui Agricultural Sciences*, 35 (4): 1009-1010.
3. Yanan Xing, Yang Zheng, Jianjun Hao, et al. (2006). Influence of $KHCO_3$ on the cucumber seedling photosynthesis. *Journal of Anhui Agricultural Sciences*, 34(3): 421-423.
4. Xianzhen Zhang (1992). *Crop physiology research*. Beijing: Agricultural Press.
5. Qilin Cheng, Lun Shan, Zhihui Cheng, et al. (2000). Influence of low temperature and weak light on cucumber thylakoid membrane coupling condition.

6. Journal of Northwest Agricultural University, 28 (16): 6-11.
6. Chunmei Wang, Dingji Shi, Shuifang Zhu, et al. (2000). Influence of cucumber mosaic virus on tobacco leaf and chloroplasts photosynthetically activity. *Acta Botanica Sinica*, 42 (4): 388-392.
7. Hesheng Li (2000). *Principle and technology of Plant physiological and biochemical experiments*. Beijing: Higher Education Press.
8. Fusheng Feng, Ligeng Ma. Influence of low temperature on PEP carboxylase and its control characteristics of corn leaf. *Journal of Plant Physiology*, 1992, 18(1):45-49.
9. Yonghua Dong, et al. (1995). Influence of ethylene on wheat seedlings PEP carboxylase activity under drought conditions. *Journal of Hebei Agricultural University*, 18(3):26-30.
10. Bingsong Zheng, et al. (2002). Influence of K nutrition on plant photosynthesis rate, Rubisco and RCA. *Journal of Zhejiang Forestry College*, 19(1):104-108.
11. Yingchang Li, Jianjun Hao, Yang Yu, et al. (2006). Effect of $NaHSO_3$ on photosynthesis of eggplant seedling. *Northern Horticulture*, (5):11-13.
12. Lihua Rao, Jianmei Xue (1989). Effect of K nutrition on tomatoes photosynthesis and yield formation. *Journal of Zhejiang Agricultural University*, 15(4): 341-348.
13. Camp P J, Huber S C, Burke J J, et al. (1982). Biochemical changes that occur during senescence of wheat leaves. *Plant Physiology*, 70:1641-1646.
14. Chen G Y, Yong Z H, Liao Y, et al. (2005). Photosynthetic acclimation in rice leaves to free-air CO_2 enrichment related to both ribulose-1,5-bisphosphate carboxylation limitation and ribulose-1,5-bisphosphate regeneration limitation. *Plant Cell Physiology*, 46: 1036-1045.
15. Spencer W, Bowes G (1986). Photosynthesis and growth of water hyacinth under CO_2 enrichment. *Plant Physiology*, 82: 528-533.



GLOBAL JOURNAL OF SCIENCE FRONTIER RESEARCH
BIOLOGICAL SCIENCE

Volume 13 Issue 3 Version 1.0 Year 2013

Type : Double Blind Peer Reviewed International Research Journal

Publisher: Global Journals Inc. (USA)

Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Soil Microbial Diversity of Dibru-Saikhowa Biosphere Reserve Forest of Assam, India

By Kumud Das, Ramesh Nath & Padum Azad

Gauhati University

Abstract - An experiment was carried out in five different sampling sites viz. Kalia, Miripathar, Bordubi, Holokhbari and Surkey area of Saikhowa range of Dibru-Saikhowa Biosphere Reserve (DSBR) Forest of Assam, India in respect of seasonal and depth wise variations in bacterial and fungal populations. The Biosphere Reserve Forest is situated in flood plain area of the mighty Brahmaputra and the Dibang rivers. Bacterial and fungal population was highest during spring season in all sites respectively. The highest microbial counts were recorded in the top soil (0-10 cm) layer except during the summer season when the population was greater in the subsurface (10-20 cm) layer. Altogether, 26 soil micro-fungal forms were recorded from five sites. *Aspergillus* and *Penicillium* were the abundant genera in all sites. Over all, soil was sandy loam and slightly alkaline in all sites. Soil organic C, total N and available P decreased with increasing soil depth. Parameters viz. water holding capacity, soil moisture content, pH, organic C, total N and available P had correlated with the microbial colony forming units (cfu). Available P revealed a significant positive correlations with bacterial and fungal cfu as well as inverse correlations with water holding capacity, organic C and organic matter.

Keywords : *microbial populations, soil physico-chemical parameters, dibru-saikhowa biosphere reserve forest manuscript received "04-05-13".*

GJSFR-C Classification : FOR Code: 961499, 620399p



Strictly as per the compliance and regulations of :



Soil Microbial Diversity of Dibru-Saikhowa Biosphere Reserve Forest of Assam, India

Kumud Das^α, Ramesh Nath^σ & Padum Azad^ρ

Abstract - An experiment was carried out in five different sampling sites viz. Kalia, Miripathar, Bordubi, Holokhbari and Surkey area of Saikhowa range of Dibru-Saikhowa Biosphere Reserve (DSBR) Forest of Assam, India in respect of seasonal and depth wise variations in bacterial and fungal populations. The Biosphere Reserve Forest is situated in flood plain area of the mighty Brahmaputra and the Dibang rivers. Bacterial and fungal population was highest during spring season in all sites respectively. The highest microbial counts were recorded in the top soil (0-10 cm) layer except during the summer season when the population was greater in the subsurface (10-20 cm) layer. Altogether, 26 soil micro-fungal forms were recorded from five sites. *Aspergillus* and *Penicillium* were the abundant genera in all sites. Over all, soil was sandy loam and slightly alkaline in all sites. Soil organic C, total N and available P decreased with increasing soil depth. Parameters viz. water holding capacity, soil moisture content, pH, organic C, total N and available P had correlated with the microbial colony forming units (cfu). Available P revealed a significant positive correlations with bacterial and fungal cfu as well as inverse correlations with water holding capacity, organic C and organic matter.

Keywords : *microbial populations, soil physico-chemical parameters, dibru-saikhowa biosphere reserve forest manuscript received "04-05-13".*

I. INTRODUCTION

Soil is a dynamic, biological system that is an essential part of the terrestrial ecosystem. The functions of soil biota are central to decomposition processes and nutrient cycling. Soil microorganisms play an important role in soil processes that determine plant productivity. Soil fungi make a very important part of the ecosystem along with other microbes in turnover of the biomass (James & Hyde 1998).

There is an urgent need to conserve biodiversity at global level to preserve the endemic and endangered species, both microscopic and macroscopic which plays vital role for the maintenance of sustainable environment, agriculture and forestry (Jha *et al.* 2002). Microbial diversity plays a dominant role in the maintenance of ecosystem. Soil microorganisms are the major organisms responsible for controlling the amount

of nutrient cycling and for controlling the amount of nutrient available to plants (Hernot & Robertson 1994; Singh & Rai 2004; Jain *et al.* 2005). The soil microbes decompose the plant and animal residues entering the soil and convert them into soil organic matter, which influences on soil physical, chemical and biological properties and on creating a complimentary medium for biological reactions and life support in the soil environment (Olson *et al.* 2000). Soil fertility status is dependent upon soil microbial component and their mediated processes (Lynch 1984).

This study deals with the seasonal and depth wise variations in soil bacterial and fungal populations in relation to the micro-environmental and soil nutrient variability in Dibru-Saikhowa Biosphere Reserve (DSBR) Forest of Assam, India. North eastern region of India including Assam is a potential biodiversity area and so it is included in 19 mega diversity regions of the world and 12 diversity areas of the country. A number of studies on the distribution of forest soil micro fungi in terrestrial ecosystem. Some studies dealt with depth effects (Arunachalam *et al.* 1997) and others attempted to examine seasonal trends (Kennedy *et al.* 2005). However, the rate at which organic matter is decomposed by the microbes is interrelated to the chemical composition of the substrate as well as environmental conditions. Substantial works for conservation of diversity and preservation of their genetic resources have done but works on microbial dynamics is very meager in this region. To go about the aforementioned approach, data on the seasonal and depth wise variations in bacterial and fungal populations in DSBR forest had consummated and discussed in this paper to derive some conclusions regarding the influence in relation to micro-environmental and soil nutrient variability on the microbial population dynamics.

II. MATERIALS AND METHODS

a) Study Area

Dibru-Saikhowa Biosphere Reserve forest is located between 27° 35' - 27° 50' North latitude and 95° 10' to 95° 40' East longitude. It is a safe haven for many extremely rare and endangered species of wild life including 300 avifauna and various species of shrubs, herbs and medicinal plants. Wetlands cover sixty percent of the total area while forest and grassland covers 25 and 15 percent respectively. The mean annual

Author α : Life Sciences Division, Institute of Advanced Study in Science and Technology (IASST), Guwahati-35, Assam, India.

E-mail : das.kumud@yahoo.co.in

Author σ : Department of Zoology, Dhing College, Nagaon, Assam, India. E-mail : rameshnathdhing@gmail.com

rainfall ranges between 2300 to 3600 mm in different localities within the sampling areas. The temperature remains moderate and the annual temperature varies from 6° to 36°C while the humidity varies from 64 to 68 percent respectively in all the study sites experiencing a humid tropical climate (Dutta *et al.* 1997). The reserve forest is mainly consisted of semi wet evergreen forests and tropical moist deciduous forest Champion *et al.* 1968). Total area of the reserve forest is 340 sq km comprising two ranges *viz.* Dibru and Saikhowa.

b) Soil Sampling and Analysis

Soil from three depths (*viz.* 0-10, 10-20 and 20-30 cm) were sampled during January, March, May and November that are the representative months of winter, spring, summer and autumn seasons. In each stand, five replicates of soil samples were collected aseptically in sterilized polythene bags using a steel corer (6.5cm inner diameter) and were used for the isolation of bacteria and fungi within 24 h. The water holding capacity, pH and soil moisture content were determined by standard method Trivedi *et al.* 1987. The remaining soil samples were air dried and taken to the laboratory at the Department of Life Sciences, Institute of Advanced Study in Science and Technology, Guwahati, Assam for analysis of soil physical and chemical properties. Particle size composition was determined using the hydrometer method Bouyoucos 1962; organic carbon by the Walkley-Black method (Walkley & Black 1934), after which values obtained were multiplied by 1.72 (Pluske *et al.*, 2009) to convert to organic matter; total nitrogen by the Kjeldahl method (Bremner & Mulvaney 1982); available phosphorus was determined by the method of Bray & Kurtz 1954.

c) Isolation of Bacterial and Fungal Population

Soil bacterial population was estimated by the method of Waksman 1952 using the nutrient agar medium at 10⁵ dilutions. The inoculated petri-dishes were incubated at 30± 1°C for 24 h for 5 days for bacterial colonies. For isolation and characterization of fungi dilution plate method was used at 10³ dilutions in distilled water. Potato dextrose agar, czapek dox agar and fungal agar media were used as basal medium to isolate and characterization of fungal species (Cappucino & Sherman 1983, Warcup1955). The inoculated petri-dishes were incubated at 25 ± 1°C for 5 days for growing the fungal colonies. Representative isolates of fungi were identified under the microscope with the help of standard manuals (Gilman 1995, Barnett & Hunter 1972).

d) Data Analysis

To calculate the populations of bacteria and fungi, colonies developed on petri dishes were counted with the help of digital colony counter and expressed as number of colony forming units (cfu) gm⁻¹ of dry soil.

III. RESULTS

a) Physico-Chemical Properties

The highest (64.36) and the lowest (30.82) percentage of water holding capacity and moisture content (32.2) and (15.5) were recorded in Bordubi and Miripathar area respectively. The maximum (8.52) and minimum (7.65) pH were recorded in Surkey and Kalia area respectively and both the highest (0.91) and lowest (0.32) percentage of organic carbon was recorded in Kalia area. The highest (1.575) and lowest (0.563) percentage of soil organic matter were also recorded in Kalia area. The range of available phosphorus was recorded as 1.124 to 1.893 ppm and nitrogen content was recorded as 0.164 to 0.398 gm⁻¹ of soil. (Table 1).

b) Microbial Population Dynamics

Table 2 revealed that the bacterial and fungal counts were greater in the surface (0-10 cm) layer of the soil as compared to others. The maximum bacterial and fungal population was recorded in spring season in all the sites and minimum during winter. During rainy season, maximum microbial count was, however, recorded in the subsoil (10-20 cm) layer. Both bacterial and fungal cfu's were more in Kalia, Miripathar and Surkey sites than in Holokhbhari and Bordubi. Quantitatively, bacterial counts were always high as compared to fungal population in all the sites. In general, similar trend was observed in the distribution of soil microorganisms in all the sites. (Table 2).

c) Microbial Population

During the investigation period, about 26 nos. of different dominant fungal species were observed in all the study sites of Dibru-Saikhowa Biosphere Reserve Forest. The relative proportion of different fungal taxonomic groups was almost identical in all the five sites. *Penicillium* and *Aspergillus* were the most abundant group of species in all the five sites. However, some species were restricted to a particular site. *Aspergillus fumigatus*, *Trichoderma viride* and *Rhizopus* sp. were exclusively found in Kalia, while *Curvularia* sp. was encountered only in Miripathar area. (Table 3).

d) Correlation Analysis

Over all, soil was sandy loam and slightly alkaline in all sites (Table 1). Among the soil physico-chemical properties, available P show significant positive correlations with bacterial and fungal cfu (<0.05); water holding capacity, organic C and organic matter showed negative correlations. The soil moisture content, pH and total N showed both positive and negative correlations equally for bacterial and that of fungal populations. (Table 4).

IV. DISCUSSION

Top layer soil (0-10 cm) contains high organic matter, which in the presence of adequate moisture supply is acted upon by the microorganisms to decompose the complex organic residues into simpler forms; hence, microbial counts are generally higher in the surface soil layer as compared to the lower depths (Shamir & Steinberger 2007). However, the distribution of soil microbial population is determined by a number of environmental factors like pH, moisture content and soil organic matter (Kennedy *et al.* 2005). Higher bacterial population in the topsoil (0-10 cm) layer during spring season in present study is in agreement with the observation who recorded higher populations during spring and post-rainy seasons (Jha *et al.* 1992a). However, peak in bacterial population was recorded during rainy season may be attributed to favorable soil moisture and temperature conditions that coincide with greater microbial activity and decomposition. The litter and other plant residues are decomposed faster during rainy season and sufficient soil organic matter and humus accumulates that may have enhanced the colonization of the soil microbes in subsequent period (Arunachalam 1997). Maximum population in the subsoil (10-20 cm) layer during rainy season in all the five sites studied correlated (Classen *et al.* 2007) who pointed out that during hot summer months, the sub-layer of soil occasionally harbors more fungal populations caused by temperature and moisture regimes than the topsoil layer. Higher rate of infiltration in the loamy sand may also in part have contributed to this phenomenon. Further, overall reduction in microbial population in the lower soil depths was attributed to fewer amounts of minerals, low oxygen content and increased carbon-dioxide concentration (Shukla *et al.* 1989). Consequently fungal flora noted in the deeper depths of soil was significantly low in all the five sites. During winter, low moisture content might have slowed down microbial activity and organic matter decomposition and thus resulted in a low microbial population.

A total of 26 soil microfungi were isolated (Table 3). However, only a few fungal species were found to be dominant and basically no marked variations in the composition of species were noticed in different seasons of the year across the sites. The species like *Aspergillus*, *Penicillium* and *Rhizopus* were common to all sites. Dominance of the genus *Penicillium* and *Aspergillus* in the present study sites may be due to their greater rate of spore production and dispersal and partly due to their resistance over extreme environmental conditions (Schimel 1995). The fungal species richness recorded in the present study was higher than those (13 species) reported from subtropical humid forest soils in north-east India and 26, 21 and 27 species, respectively from soils of valley land, terrace and slopes in this region (Kennedy *et al.* 2000; Shukla & Mishra 1992).

The topsoil layer (0-10 cm) had 20 species which was greater than the subsoil layer (10-20 and 20-30 cm) (Table 3). Fungi grow slowly in the deeper soil layers due to shortage of mineral nutrients and compaction of soil along depth (Dkhar 1983). The rate of change in fungal population was attributed to the type of vegetation growing on a particular area (Entry & Emmingham 1996), variation in physico-chemical characteristics of the soil and environmental complex of the locality (Bossio *et al.* 2005). Higher counts of bacterial and fungal population in Kalia, Miripathar and Surkey sites may be attributed to the dense growth of plants and greater availability of nutrients on account of greater accumulation of litter and may also be due to spreading of other biodegradable wastes in the system. Contrarily, low microbial population in Bordubi and Holokhbari sites may be because addition of plant remains and other organic wastes in these sites was comparatively poor that also resulted in low organic matter content in the soil. Many workers have also recorded a correlation between fungal species composition and the species composition of the aboveground vegetation (Chung *et al.* 2007). Several microbes promote plant growth and many microbial products that stimulate plant growth. They were described the conditions under which bacteria live in the rhizosphere. To exert their beneficial effects, bacteria usually must colonize the root surface efficiently. They also described several mechanisms by which microbes can act beneficially on plant growth are described *viz.* biofertilization, stimulation of root growth, rhizoremediation and plant stress control (Lutenberg & Kamilova 2009).

V. CONCLUSION

The present study concludes that the population of bacteria and fungi in the soils of Dibru-Saikhowa Biosphere Reserve Forest are influenced by vegetation, physico-chemical properties and species composition. However, the role of macro and micro-climatic seasonality and soil nutrient status cannot be completely ruled out. It is also understood that the quality of plant residues accumulating in these sampling sites are furthermore important and may play a vital role in soil nutrient management within the system through microbial decomposition.

VI. ACKNOWLEDGMENTS

We thank the official staff and forest guards of Saikhowa range of the Dibru-Saikhowa Biosphere Reserve Forest for their assistance/cooperation during the field study. The authors are also thankful to the Ministry of Environment and Forest (MoEF), New Delhi, India for financial assistance in the mode of three years research project.

REFERENCES RÉFÉRENCES REFERENCIAS

1. Arunachalam, K., Arunachalam, A., Tripathi, R. S. and Pandey, H. N. (1997) Dynamics of microbial population during the aggradation phase of a selectively logged subtropical humid forest in Northeast India. *Trop. Ecology* 38, 333-341.
2. Barnett, H. L. and Hunter, B. B. (1972) *Illustrated Genera of Imperfect Fungi*, Burgess Publishing Company, Minneapolis, Minnesota, USA.
3. Bossio, D. A., Girvan, M. S., Verchot, L., Bullimore, J., Borelli, T., Albrecht, A., Scow, K. M., Ball, A. S., Pretty, J. N. and Osborn, A. M. (2005) Soil microbial community response to land use change in an agricultural landscape of Western Kenya. *Microb. Ecol.* 49, 50-62.
4. Bouyoucos, G. J. (1962) Hydrometer method for making particle size analysis of soils. *In: Proceedings Soil Science Society of America* 26, 464-465.
5. Bray R. H. and Kurtz, L. T. (1954) Determination of total, organic and available forms of phosphorus in soils. *Soil Science*. 59, 39-45.
6. Bremner, J. M. and Mulvaney, C. S. (1982) Nitrogen. *In: The Method of Soil Analysis: Agronomy. Monogram*, Ed. A. I. Page, R. H. Miller, and D. R. Keeney, ASA, Madison, Wis, USA.
7. Cappuccino, J. G. and Sherman, N. (1983) *Microbiology: A Laboratory Manual*, Addition-Wesley Publishing Company.
8. Champion, H. G. and Seth, S. K. (1968) *A revised survey of forest types of India*, The manager of publication, Delhi, India.
9. Chung, H., Zak, D. R., Reich, P. B. and Ellsworth, D. S. (2007) Plant species richness, elevated CO₂ and atmospheric nitrogen deposition alter soil microbial community composition and function. *Global Change Biol.* 13, 980-989.
10. Classen, A. T., Overby, S. T., Hart, S. C., Koch G. W. and Whitham, T. G. (2007) Season mediates herbivore effects on litter and soil microbial abundance and activity in a semi-arid woodland. *Plant Soil*. 295, 217-227.
11. Dkhar, M. S. (1983) Studies on ecology of edaphic microbial populations and their activities in maize fields. *Ph. D. Thesis*, North-Eastern Hill University, Shillong, India.
12. Dutta S. and Phukan, M. (1997) *Asom Abhayaranya Aru Rashtriya Uddyan*. Published by Nature's Beckon, Assam, India.
13. Entry, J. A. and Emmingham, W. H. (1996) Influence of vegetation on microbial degradation of atrazine and 2, 4-dichlorophenoxyacetic acid in riparian soils. *Can. J. Soil Sci.* 76, 101-106.
14. Gilman, J. C. (1995) *A Manual of Soil Fungi*, Printwell Publications, Jaipur, India.
15. Hernot, J. and Robertson, G. 1994. Vegetation removal in two soils of the humid tropics: Effect on microbial biomass. *Soil Biol. Biochem.* 15, 93-99.
16. Jain, R. K., Kapur, M., Labana, S., Lal, B., Sarma, P. M., Bhattacharya, D. and Thakur, I. S. (2005) Microbial diversity: Application of micro-organisms for the degradation of xenobiotics. *Current Science* 89 (1), 101-112.
17. James, E. B. G. and Hyde, K. D. (1998) Methods for the study of Mangrove Marine Fungi, *In: Mangrove Microbiology, Role of Microorganisms in Nutrient cycling of Mangrove soils and waters*, Ed by A. D. Agate, C. V. Subramanian and H. Vannucci, pp. 9-27, UUNDP.
18. Jha, D. K., Ahanthem, S and Singh, K. N. (2002) Structural and Functional Diversity of Bacteria, Microbial Diversity: Status and Potential Applications. pp. 54-67 Scientific Book Centre, Guwahati, India.
19. Jha, D. K., Sharma, G. D. and Mishra, R. R. (1992a) Soil microbial population numbers and enzyme activities in relation to altitudes and forest degradation. *Soil Biol. Biochem.* 24, 761-767.
20. Kennedy, N. M., Gleeson, D. E., Connolly, J. and Clipson, N. J. W. (2005) Seasonal and management influences on bacterial community structure in an upland grassland soil. *FEMS Microb. Ecol.* 53, 329-337.
21. Lutenberg, B. and Kamilova, F. (2009) The beneficial effect of rhizobacteria on plant growth through direct or indirect mechanisms. *Annual Review of Microbiology*, 63, 541-556.
22. Lynch, J. M. (1984) Interactions between biological process, cultivation and soil structure. *Plant and soil* 76, 307-318.
23. Olson, R. K., Schoeneberger, M. M. and Aschmann, S. G. (2000) An ecological foundation for Temperate Agroforestry. *In: North American Agroforestry, An Integrated Science and Practice*, Eds. H. E. Garrett, W. J. Rietveld and R. F. Fisher, pp. 31-61, Wisconsin, USA: American Society of Agronomy, Madison.
24. Schimel, J. (1995) Ecosystem consequences of microbial diversity and community Structure. *Ecological studies*, Eds: Chapin and Korner, 113, pp. 239-254,
25. Shamir, I. and Steinberger, Y. (2007) Vertical distribution and activity of soil microbial population in a sandy desert ecosystem. *Microb. Ecol.* 53, 340-347.
26. Shukla, A. K. and Mishra, R. R. (1992) Influence of soil management systems on the microfungal communities of potato field. *Cryptogamie Mycol.* 13, 135-144.
27. Shukla, A. K., Tiwari B. K. and Mishra, R. R. (1989) Temporal and depthwise distribution of microbes,

- enzyme activities and soil respiration in potato field soil under different agricultural systems in north eastern hill region of India. *Revue a Ecologie et de Biologie du sol*. 26, 249-265.
28. Singh, S. K. and Rai, J. P. N. (2004) Soil microbial population and enzyme activity related to grazing pressure in Alpine meadows of Nanda Devi Biosphere Reserve. *Jr. of Environ. Biol.* 25 (1),103-107
29. Trivedi, R. K., Goel, P. K. and Trisal, C. L. (1987) *Practical Methods in Ecology and Environmental Science*, Environ Media Publications, Karad, India.
30. W. Pluske, D. Murphy, and J. Sheppard (2009) Organic Carbon. *www.soilquality.org.au*.
31. Waksman, S. A. (1952) *Soil Microbiology*, John Wiley and Sons, New York.
32. Walkley, A. and Black, I. A. (1934) An examination of the detjareff method for determining soil organic matter and a proposed modification to the chronic acid titration method. *Soil Science*. 37, 29-38.
33. Warcup, J. H. (1955) The soil plate method for isolation of fungi from soil. *Nature*. 166, 117-118.

Table 1 : Physico-chemical parameters of soil samples collected from Saikhowa Range of Dibru-Saikhowa Biosphere Reserve Forest

Sampling Sites	Soil depth (cm.)	Texture	WHC (%)	SMC (%)	pH	Organic Carbon (%)	Soil Organic Matter (%)	Available P (ppm)	Nitrogen (gm ⁻¹)
Kalia area	0-10	SL	61.10±0.315	28.8±0.10	7.65±0.015	0.91±0.015	1.575±0.026	1.636±0.031	0.383±0.007
	10-20		54.10±0.374	24.2±0.05	7.89±0.015	0.34±0.006	0.598±0.010	1.478±0.005	0.372±0.008
	20-30		34.77±0.392	19.4±0.10	8.33±0.010	0.32±0.015	0.563±0.026	1.312±0.003	0.266±0.013
Miripathar area	0-10	SS	30.82±0.224	15.5±0.05	8.27±0.012	0.33±0.030	0.575±0.053	1.243±0.003	0.324±0.011
	10-20		53.64±0.395	25.3±0.06	8.04±0.015	0.54±0.040	0.942±0.070	1.154±0.005	0.297±0.019
	20-30		58.71±0.180	25.8±0.05	8.25±0.020	0.63±0.015	1.092±0.027	1.142±0.004	0.174±0.013
Bordubi area	0-10	SS	63.47±0.225	23.1±0.17	8.01±0.013	0.43±0.017	0.669±0.096	1.323±0.009	0.164±0.010
	10-20		63.53±0.402	32.1±0.15	8.01±0.015	0.60±0.015	0.951±0.090	1.452±0.004	0.379±0.015
	20-30		64.36±0.267	32.2±0.15	7.74±0.005	0.43±0.015	0.753±0.026	1.433±0.004	0.383±0.009
Holokhbari area	0-10	SS	54.30±0.157	26.8±0.10	8.42±0.015	0.84±0.005	1.459±0.009	1.268±0.003	0.310±0.018
	10-20		40.73±0.083	25.7±0.05	8.45±0.020	0.74±0.021	1.287±0.035	1.561±0.001	0.398±0.018
	20-30		60.53±0.166	29.4±0.15	8.31±0.015	0.79±0.010	1.362±0.017	1.586±0.002	0.224±0.011
Surkey area	0-10	SL	59.80±0.125	25.8±0.06	8.13±0.015	0.51±0.015	0.885±0.026	1.893±0.002	0.168±0.007
	10-20		44.25±0.119	25.6±0.06	8.52±0.025	0.56±0.015	0.977±0.026	2.124±0.106	0.336±0.009
	20-30		52.13±0.125	21.3±0.15	8.02±0.013	0.61±0.015	1.112±0.053	1.323±0.004	0.266±0.013

CD at 5% level, SL=Sandy Loam; SS= Sandy Silt; WHC= Water Holding Capacity; SMC= Soil Moisture Content Values presented in the table are mean of three replications and SE

Table 2 : Seasonal variations of bacterial cfu ($\times 10^5$ g⁻¹ dry soil) and fungal cfu ($\times 10^3$ g⁻¹ dry soil) at three soil depths (cm)

Sampling Sites	Soil depths	Bacterial (cfu)				Fungal (cfu)			
		A	W	SP	S	A	W	SP	S
Kalia area	0-10	112.67	105.20	145.67	135.10	46.00	67.00	110.33	104.00
	10-20	100.72	98.67	112.67	106.33	100.33	58.33	114.00	69.00
	20-30	38.60	13.10	61.70	53.00	12.10	41.10	50.00	23.33
Miripathar area	0-10	118.60	145.00	169.67	99.52	109.69	93.00	146.67	129.33
	10-20	104.00	42.00	97.33	88.00	18.00	43.10	100.33	56.00
	20-30	42.00	21.10	41.33	33.33	22.10	36.10	100.00	64.15
Bordubi area	0-10	91.00	97.67	123.00	114.33	88.00	56.30	156.00	100.33
	10-20	83.00	60.00	93.33	95.67	23.33	54.67	118.00	65.33
	20-30	12.00	10.00	34.33	45.67	25.00	42.20	36.33	56.00

Holokhbari area	0-10	109.20	110.00	173.33	133.67	103.10	55.00	116.33	108.33
	10-20	47.00	56.00	87.00	98.30	29.67	33.00	68.00	46.33
	20-30	19.00	10.50	63.00	60.00	19.17	30.00	35.00	38.60
Surkey area	0-10	89.10	99.00	171.33	169.20	141.10	106.67	156.33	148.33
	10-20	68.00	76.00	101.00	111.33	40.00	65.60	78.33	98.33
	20-30	9.67	23.00	34.00	22.00	23.10	15.10	56.00	28.00

A: Autumn; W: Winter; SP: Spring; S: Summer;

Values presented in the table are mean of three replication

Table 3: Microfungi isolated from three soil depths in five sampling sites of Saikhowa Range of Dibru-Saikhowa Biosphere Reserve Forest

Name of the species	Kalia area			Miripathar area			Bordubi area			Holokhbari area			Surkey area			No. of colonies (gm ⁻¹ of soil)	Percent Contribution
	0-10	10-20	20-30	0-10	10-20	20-30	0-10	10-20	20-30	0-10	10-20	20-30	0-10	10-20	20-30		
<i>Absidia spinosa</i> Lendner	-	+	-	+	-	-	+	-	-	+	-	-	+	-	-	12.00±0.08	1.10
<i>Aspergillus</i> Mich. ex. Fr.	+	-	+	-	-	-	-	-	-	-	-	-	+	-	-	81.00±3.06	7.42
<i>Aspergillus clavatus</i> Desm.	-	-	-	-	-	-	-	+	-	+	-	-	+	-	-	74.65±0.81	6.84
<i>Aspergillus flavus</i> Linker Gray.	+	+	-	+	-	-	+	-	-	-	+	-	-	-	-	27.34±0.50	2.51
<i>Aspergillus fumigatus</i> Fres.	-	+	-	-	-	-	-	+	-	-	+	-	-	+	+	69.32±0.45	6.35
<i>Aspergillus niger</i> Van Tieghem.	+	-	-	+	-	-	+	-	-	+	-	-	+	+	-	51.30±0.42	4.70
<i>Aspergillus terreus</i> Corda.	+	-	-	-	-	-	+	-	-	+	+	-	-	-	-	78.00±1.70	7.15
<i>Biospora</i> Boedijn.	+	-	-	+	-	+	-	-	-	-	+	-	+	-	-	10.66±0.35	0.98
<i>Curvularia</i> Boedijn.	+	-	-	+	-	-	+	+	-	+	-	-	-	+	-	39.42±0.74	3.61
<i>Curvularia lunata</i> (Wakker) Boedijn.	-	+	-	+	-	-	-	+	-	+	+	-	-	-	-	23.43±1.33	2.15
<i>Fusarium moniliforme</i> Sheld.	+	-	-	-	-	-	+	+	-	+	-	-	-	-	-	34.20±0.32	3.13
<i>Fusarium oxysporum</i> Schl.	-	+	-	+	+	-	+	-	-	-	-	-	+	+	-	63.13±1.22	5.78
<i>Mucor</i> Mich. ex. St. -Am.	+	+	-	+	-	-	-	+	-	+	+	-	+	-	-	42.33±0.67	3.88
<i>Mucor mucedo</i> Mich. ex. St. -Am.	+	+	-	-	-	-	-	+	-	-	+	-	-	+	-	43.53±0.74	3.99
<i>Penicillium</i> Link. ex. Fr.	-	+	-	+	+	-	+	+	-	-	-	-	+	-	-	73.00±1.56	6.69
<i>Penicillium chrysogenum</i> Thom	+	+	+	-	+	+	-	+	+	-	+	+	+	+	+	20.11±0.72	1.84
<i>Penicillium claviforme</i> Bain.	+	-	-	-	-	-	+	-	-	-	+	-	-	+	-	66.00±0.51	6.05
<i>Penicillium sacculum</i> Dale.	+	-	-	+	-	+	-	+	-	+	-	-	+	-	-	7.33±0.54	2.50
<i>Penicillium spinulosa</i> Thom.	-	+	-	-	-	-	+	-	-	-	+	-	-	-	-	13.10±0.45	1.20
<i>Rhizoctonia solani</i> Kuhn.	-	-	-	+	-	-	-	+	-	+	-	-	+	+	-	38.10±1.57	3.49
<i>Rhizopus</i> Ehrenb.	+	+	-	-	-	-	+	-	-	-	-	-	+	-	+	60.38±1.91	5.53
<i>Rhizopus stolonifer</i> Exrenb. ex. Link.	-	+	-	-	+	+	-	+	-	-	+	+	-	-	+	42.65±0.50	3.91
<i>Sclerotium rolfsii</i> Sacc.	+	-	-	-	-	+	+	-	-	-	+	-	-	+	-	6.23±0.16	0.57
<i>Trichoderma</i> Pers. ex. Fr.	+	+	-	+	-	-	-	-	-	+	+	-	+	-	-	59.16±1.39	5.42
<i>Trichoderma koningi</i> Pers. ex. Fr.	+	-	-	-	+	-	+	-	-	-	-	-	-	+	-	11.36±0.41	1.04
<i>Trichoderma viride</i> Pers. ex. Fr.	-	+	-	+	-	-	-	-	-	+	-	-	+	-	-	23.65±0.25	2.17

Sign '-' and '+' indicates absence and presence of microfungi respectively Values presented in the table are mean of three replications and SE

Table 4 : Correlation coefficient (r) for the relationships between bacterial and fungal cfu and soil physico-chemical parameters of the collected soil samples

Soil depths	WHC	Soil Moisture	PH	Organic C	Organic Matter	Available P	Total N
Bacteria							
0-10	-0.985**	-0.874	0.375	-0.532	-0.483	0.395	0.346
10-20	0.311	-0.323	-0.530	-0.970**	-0.955*	0.112	-0.161
20-30	-0.472	-0.206	0.836	-0.060	-0.115	0.061	-0.485
Fungi							
0-10	-0.307	-0.435	0.455	-0.690	-0.653	0.368	-0.574
10-20	0.382	-0.107	-0.460	-0.888*	-0.906*	0.260	-0.042
20-30	0.381	0.258	-0.037	0.058	0.031	0.673	-0.358

** p<0.05; *p<0.01, N=5

This page is intentionally left blank



Antifungal Activities of Essential Oils and Crude Extracts of Some Aromatic Plants against *Fusarium* Rot of *Trichosanthes Dioica*

By Bina Wagle & Usha Budathoki

Tribhuvan University, Kirtipur, Kathmandu

Abstract - This experiment was conducted for assessing the antifungal activities of essential oils and crude extracts of some aromatic plants against *Fusarium* rot of *Trichosanthes dioica* was at the Central Department of Botany. Pathogenicity test was taken for the confirmation of disease by transferring the inoculum from pure culture. For the control of the above fungus essential oils and extracts of five aromatic plants *Zanthoxylum armatum*, *Mentha arvensis*, *Amomum subulatum*, *Valeriana jatamansi* and *Cymbopogon flexuosus* were used. Each oil and extracts were diluted in different concentration in 80% acetone and in distilled water respectively. The value of minimum inhibitory concentration and percentage of mycelia growth inhibition of oil and extracts were obtained as, oil of *C. flexuosus* showed the highest fungitoxicity (100%) at the 5.0 and 50 μml^{-1} concentration followed by *Z. armatum*, *M. arvensis*, *A. subulatum* and *V. jatamansi* were found to be 10 and 100 μml^{-1} respectively also the highest percentage of mycelial growth inhibitors were found to be *C. flexuosus* followed by *A. subulatum*, *Z. armatum*, *M. arvensis* and *V. jatamansi*.

Keywords : inoculum, minimum inhibitory concentra-tion, mycelial growth, pathogenicity.

GJSFR-C Classification : FOR Code: 270499



Strictly as per the compliance and regulations of :



Antifungal Activities of Essential Oils and Crude Extracts of Some Aromatic Plants against *Fusarium* Rot of *Trichosanthes Dioica*

Bina Wagle ^α & Usha Budathoki ^σ

Abstract - This experiment was conducted for assessing the antifungal activities of essential oils and crude extracts of some aromatic plants against *Fusarium* rot of *Trichosanthes dioica* was at the Central Department of Botany. Pathogenicity test was taken for the confirmation of disease by transferring the inoculum from pure culture. For the control of the above fungus essential oils and extracts of five aromatic plants *Zanthoxylum armatum*, *Mentha arvensis*, *Amomum subulatum*, *Valeriana jatamansi* and *Cymbopogon flexuosus* were used. Each oil and extracts were diluted in different concentration in 80% acetone and in distilled water respectively. The value of minimum inhibitory concentration and percentage of mycelia growth inhibition of oil and extracts were obtained as, oil of *C. flexuosus* showed the highest fungitoxicity (100%) at the 5.0 and 50 μml^{-1} concentration followed by *Z. armatum*, *M. arvensis*, *A. subulatum* and *V. jatamansi* were found to be 10 and 100 μml^{-1} respectively also the highest percentage of mycelial growth inhibitors were found to be *C. flexuosus* followed by *A. subulatum*, *Z. armatum*, *M. arvensis* and *V. jatamansi*. Similarly extracts of *C. flexuosus* followed by *Z. armatum*, *A. subulatum*, *V. jatamansi* and *M. arvensis* respectively.

Keywords : inoculum, minimum inhibitory concentration, mycelial growth, pathogenicity.

I. INTRODUCTION

Pointed gourd (*Trichosanthes dioica* Roxb) is a tropical vegetable crop, commonly found in Terai region of Nepal.

a) Post Harvest Damage

The fruits of this plant suffer a lot of damage from fungal disease during summer season. The disease forms a luxuriant wooly mycelium on the affected fruit which appears as if wrapped in absorbent cotton. The tissue in the interior of the fruit becomes watery, soft and the decaying matter emits a bad odour. The species of *Fusarium* are the commonest and most widely distributed in soil and on organic substances, which cause fruit rot on different plants. The rot of pointed gourd is carried out by *Fusarium solani* (Mart.) Sacc, Synder & Hansen.

The aim of the present study was to isolate the pathogen from infected pointed gourd and test its

pathogenicity for studying the antifungal activities of oils and extracts of different aromatic plants against the *F. solani*.

II. METHODOLOGY

The research was carried out with the following steps:

a) Collection of Host and Isolation of Pathogen

The infected pointed gourd was collected from local market of Kathmandu valley. A piece of fungal colony was transferred aseptically on a petri plate containing PDA media and was incubated in inverted position in an incubator at $25 \pm 2^\circ\text{C}$ for one week. After one week, the mycelial growth was observed under a compound microscope.

b) Identification and Pathogenicity Test

After studying and observing the characteristics features of the pathogen, it was identified as *F. solani*. The characteristics features of the fungus were identified with the help of standard literature (Booth, 1977). For pathogenicity test, the inoculum from the pure culture of *F. solani* was transferred to the healthy fruit. When incubated at $25 \pm 2^\circ\text{C}$ for 7 days, the characteristics symptoms were produced, which were found to be similar with the symptoms on fruits previously collected.

c) Maintenance of the Pure Culture

The pure culture of *F. solani* was preserved by sub-culturing in several slants and plates containing PDA media.

d) Preparation of one week old culture

The fungus from pure culture was inoculated into PDA media containing petriplates, and incubated. After seven days the inoculum disc was taken from the culture for further experiment.

e) Measurement of Spore

Measurement of spore was done by the help of ocular micrometer and stage micrometer. Ocular micrometer was calibrated by the help of stage micrometer.

Calculation of calibration factor applying the formula by:

Author ^α ^σ : Central Department of Botany, Tribhuvan University, Kirtipur, Kathmandu.

E-mails : itsmebina@hotmail.com, binawagle1@gmail.com

$$\text{One ocular division} = \frac{\text{No. of division on stage micrometer}}{\text{No. of division of ocular micrometer}} \times 10\mu\text{m}$$

Collection and extraction of essential oils and extracts of aromatic plants

Plant samples of *V. jatamansi*, *A. subulatum*, *Z. armatum*, *M. arvensis* and *C. flexuosus* each 50 gm. were collected out of these *V. jatamansi* and *A. subulatum* were hydro-distilled for 6-8 hours in Clevenger's apparatus in 500 ml water for extraction of oil and rest were taken from HPPCL (Herb Production and Processing Company Limited). Similarly the crude extract of aromatic plants were made by the help of mortar with pestle.

g) Determination of yield of essential oils

The volume of oil extracted was noted down. The yield of the essential oil was calculated in terms of % using the following formula.

$$\% \text{ of essential oil} = \frac{\text{Volume of essential oil}}{\text{Weight of sample}} \times 100$$

h) Dilution of essential oil and crude extract

Essential oils were diluted into different concentration of 0.625, 1.25, 2.5, 5.0, 10.0, μml^{-1} with 80 % acetone and each crude extracts was diluted to different concentrations, 0.625, 1.25, 2.5, 5.0, 10.0, 20, 30, 40, 50 & 100 μml^{-1} with distilled water.

i) Assessment of toxicity of oil and extract against fungal pathogen

The toxicity of the oils was assessed by using the poisoned food technique 0.5ml of each concentration of each oil and extract was taken in presterilized cooled petriplate and 9.5 ml of PDA media was poured on that with gently swirling to mix the contents thoroughly. In control set the essential oil was replaced by equal volume of acetone (80%) and the control set of crude extract was replaced by equal volume of distilled water. The inoculum disc (4mm diameter) taken from the 7 days old culture of the pathogen, was placed aseptically

at the centre of each plate and turned upside down in its position. The plates were then incubated at $25 \pm 2^\circ\text{C}$ for 7 days. All the experiments were revised thrice. The percentage inhibition of mycelial growth of test fungus was calculated separately.

j) Calculation of percentage of mycelial growth inhibition

Fungitoxicity was assessed in terms of percentage inhibition of mycelial growth of test fungus.

$$\% \text{ inhibition of mycelial growth} = \frac{g_c - g_t}{g_c} \times 100$$

Where,

g_c = growth of mycelial colony after incubation in control set i.e. diameter of colony in control set - diameter of inoculum disc

g_t = growth of mycelial colony after incubation period in treatment set i.e. diameter of the colony in treatment set - diameter of inoculum disc.

k) Determination of minimum inhibitory concentration of essential oil and extract

The minimum inhibitory concentration (MIC) is the concentration of any substance in the external medium which just inhibits cell division of a normal cell.

MIC has been expressed as the minimum dose of the essential oil and extract required for complete (100%) inhibition of mycelial growth of the test fungus.

III. RESULT AND DISCUSSION

a) Assessment of fungitoxicity of essential oils and extracts

Essential oils and extracts of different plant species showed different efficacies in the inhibition of the mycelial growth by measuring the colony size of culture plates.

Table 1 : Percentage of inhibition of *F.solani* mycelial growth using essential oils of *C. flexuosus*

S.N	Concent-ration of oil μml^{-1}	Inoculum size (mm)	Colony size (mm)			Mean colony size (mm)	Mycelial growth (mm)	% of inhibition of mycelial growth
			I	II	III			
1	0	4	42	42	42	42.00	38.00	0.00
2	0.62	4	19	18	19	18.67	14.67	61.40
3	1.25	4	12	11	12	11.67	7.67	79.82
4	2.50	4	8	7	8	7.67	3.67	90.35
5	5	4	4	4	4	4.00	0.00	100.00
6	10	4	4	4	4	4.00	0.00	100.00

Minimum inhibitory concentration (MIC) = 5 μml^{-1}

Essential oil of *C. flexuosus* showed mycelial inhibition as 0%, 61.40%, 79.82%, 90.35%, 100% & 100% at 0, 0.625, 1.25, 2.5, 5.0, 10.0 μml^{-1} oil concentration against *F.solani* respectively.

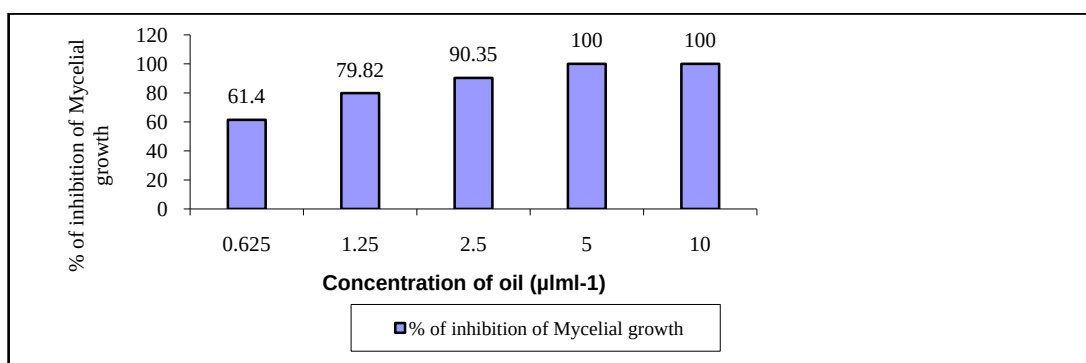


Figure 1 : Percentage of antifungal activity of *C. flexuosus* oil against *F. solani*

Table 2 : Percentage of inhibition of *F. solani* mycelial growth using extract of *C. flexuosus*

S.N	Concentration of extract µlml ⁻¹	Inoculum size (mm)	Colony size (mm)			Mean colony size (mm)	Mycelial growth (mm)	% of inhibition of mycelial growth
			I	II	III			
1	0	4	55	55	55	55.00	51.00	0.00
2	0.62	4	50	50	51	50.33	46.33	9.15
3	1.25	4	23	23	22	22.67	18.67	63.40
4	2.50	4	18	18	18.5	18.17	14.17	72.22
5	5	4	10	10	9.5	9.83	5.83	88.56
6	10	4	9	9	9	9.00	5.00	90.20
7	20	4	7	7	6.5	6.83	2.83	94.44
8	30	4	6	5	5.5	5.50	1.50	97.06
9	40	4	5	5.5	5	5.17	1.17	97.71
10	50	4	4	4	4	4.00	0.00	100.00
11	100	4	4	4	4	4.00	0.00	100.00

Minimum inhibitory concentration (MIC) = 50 µlml⁻¹

Extract of *C. flexuosus* showed mycelial inhibition as 0%, 9.15%, 63.40%, 72.22%, 88.56%, 90.20%, 94.44%, 97.06%, 97.71%, 100% & 100% at 0, 0.625, 1.25, 2.5, 5.0, 10.0, 20, 30, 40, 50, 100 µlml⁻¹ oil concentration against *F. solani* respectively.

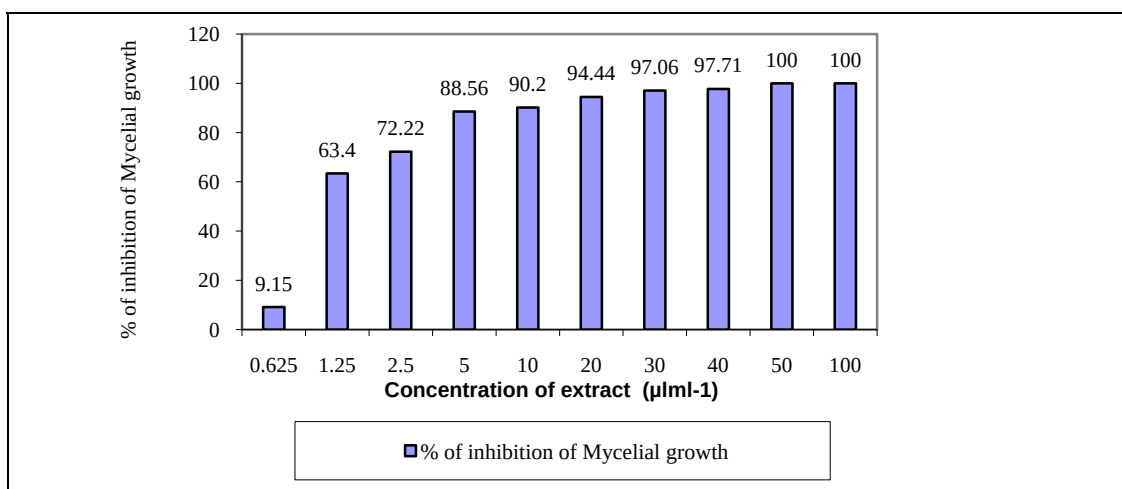


Figure 2 : Percentage of antifungal activity of *C. flexuosus* extract against *F. solani*

Minimum Inhibitory Concentration (MIC) value of Aromatic plants oils and extracts of *C. flexuosus* was 5.0 & 50.0 μml^{-1} similarly 10.0 & 100.0 μml^{-1} for *M. arvensis*, *V. jatamansi*, *A. subulatum* and *Z. armatum* respectively.

b) Comparative fungi toxicities of different essential oils

Table 3 : Comparative fungitoxicities of different essential oils in different concentrations

S.N	Concentration of oil μml^{-1}	% of Mycelial growth inhibition				
		<i>Cymbopogon flexuosus</i>	<i>Zanthoxylum armatum</i>	<i>Valeriana jatamansi</i>	<i>Mentha arvensis</i>	<i>Amomum subulatum</i>
1	0	0	0	0	0	0
2	0.625	61.4	58.77	48.61	40.35	22.76
3	1.25	79.82	71.93	70.37	53.51	35.77
4	2.5	90.35	87.77	78.7	80.26	45.53
5	5	100	97.37	85.9	92.98	97.56
6	10	100	100.00	100	100	100

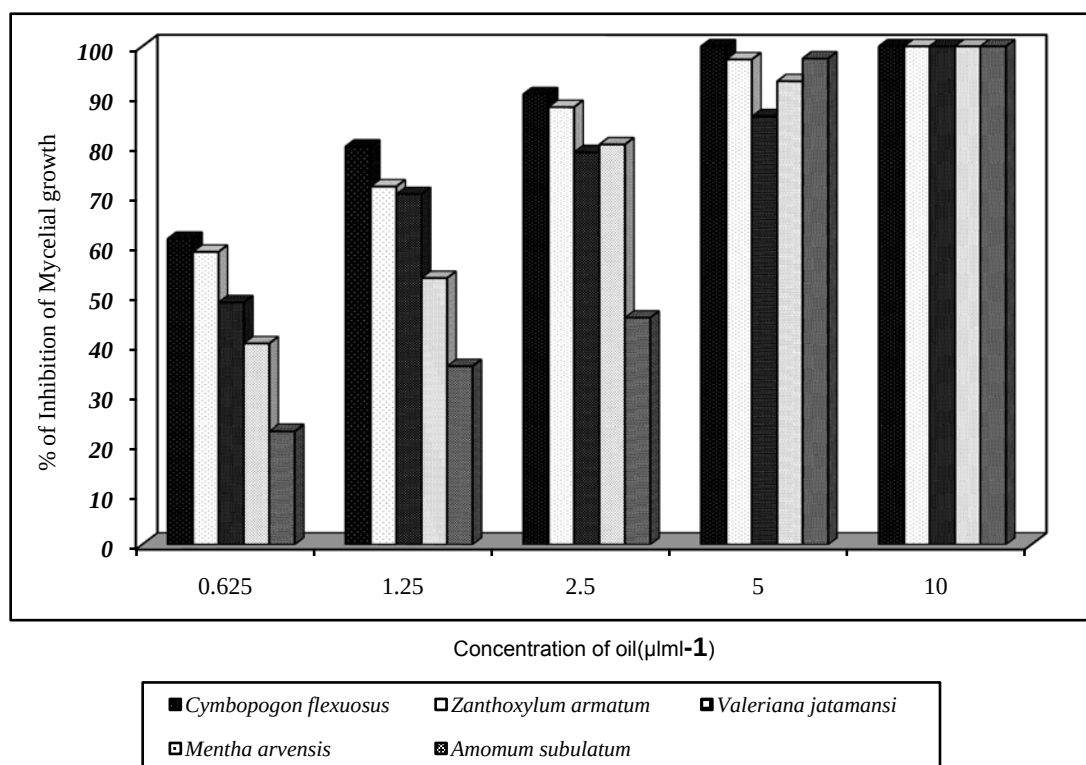


Figure 3 : Fungitoxicities of different essential oils in different concentrations

Table 4 : Comparative fungitoxicities of different extracts in different concentrations

S.N	Concentration of extract μml^{-1}	% of Mycelial growth inhibition				
		<i>Amomum subulatum</i>	<i>Zanthoxylum armatum</i>	<i>Valeriana jatamansi</i>	<i>Mentha arvensis</i>	<i>Cymbopogon flexuosus</i>
1	0	0	0	0	0	0
2	0.625	30.72	26.47	18.95	14.38	9.15
3	1.25	40.22	44.44	48.69	20.92	63.4

4	2.5	84.97	77.45	53.59	26.80	72.22
5	5	87.91	80.64	58.17	59.48	88.56
6	10	89.87	86.27	62.75	68.28	90.2
7	20	91.83	90.20	77.78	73.53	94.44
8	30	94.77	90.52	84.97	77.78	97.06
9	40	96.73	96.08	87.58	83.33	97.71
10	50	98.37	99.02	98.37	90.52	100
11	100	100	100.00	100	100	100

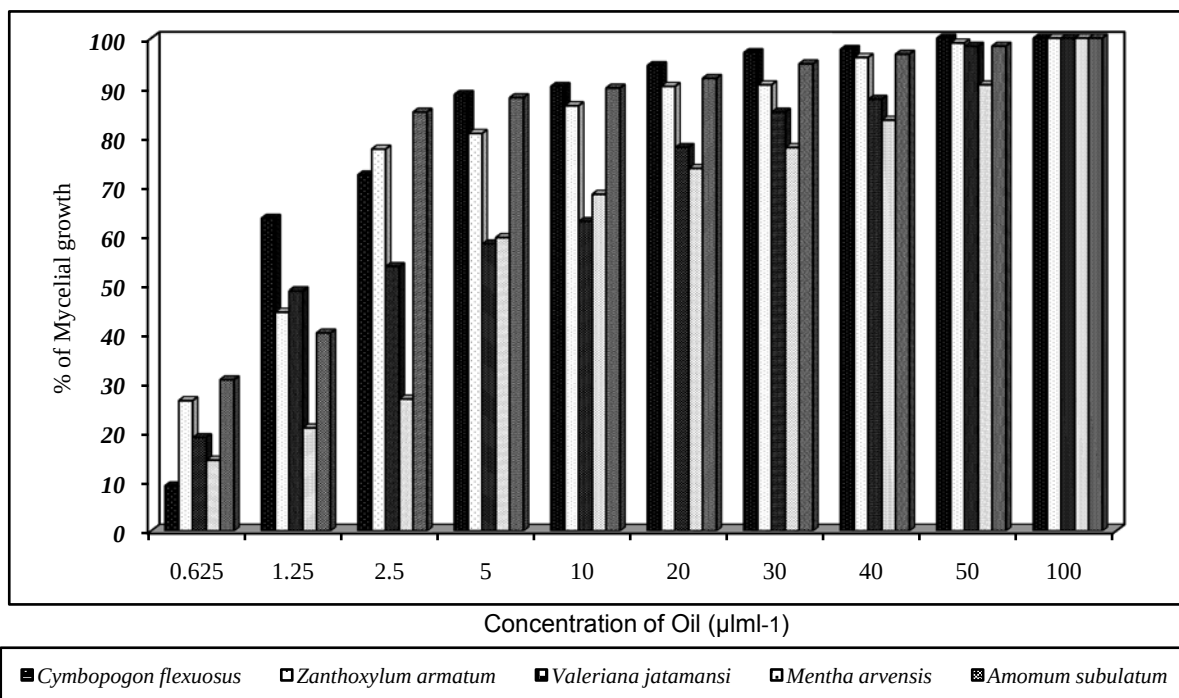


Figure 4: Fungitoxicities of different extracts in different concentrations

Out of five test plants, essential oil and extract of *C. flexuosus* was found more effective in its fungitoxic properties and showed 100% inhibition of mycelial growth of the test fungus at MIC of $5.0\mu\text{lml}^{-1}$ and $50\mu\text{lml}^{-1}$ respectively. Similarly *Z. armatum*, *V. jatamansi*, *M. arvensis*, *A. subulatum* were found effective and showed 100% mycelial growth inhibition at $10\mu\text{lml}^{-1}$ and $100\mu\text{lml}^{-1}$ respectively. Also the percentage of mycelial growth inhibition were found to be different, according to their different concentration of each essential oil and extracts, the highest percentage of mycelial growth inhibition were found to be oil of *C. flexuosus*, *Z. armatum*, *M. arvensis*, *A. subulatum* and *V. jatamansi* respectively and similarly extracts of *C. flexuosus*, *Z. armatum*, *A. subulatum*, *V. jatamansi* and *M. arvensis* respectively. Thus comparative fungitoxicities of five different essential oils and extracts were observed against *F. solani*.

A perusal of literature showed that, similar experiments for the control of *F. solani* using essential

oils and extracts has not yet been done in Nepal. So this is the first study to assess fungitoxicities of essential oils and extract against *F. solani*. This research work can be applicable for commercial scale of inhibitory activities.

IV. ACKNOWLEDGEMENTS

First of all, I would like to express my sincere gratitude and appreciation to my supervisor Professor Dr. Usha Budathoki, of Central Department of Botany, T.U. for her kind instructions, valuable suggestions, comments, guidance, encouragement and sound cooperation throughout this research work.

I am grateful to Professor Dr. Pramod Kumar Jha, Head of the Central Department of Botany, T.U. for his administrative and laboratory support. I would like to extend my thanks for all the friends who helped me to carry out this research in concrete form. Moreover, I am grateful to Er. Sunil Dhakal for his kind cooperation.

Lastly, I would like to express deepest appreciation to my Family and all of my relatives for their constant suggestions, co- operations and best wishes.

REFERENCES RÉFÉRENCES REFERENCIAS

1. Booth, C. 1977. *Fusarium: Laboratory guide to the identification of Major species*, Commonwealth Mycological Institute, Kew, Surrey, U.K.
2. Faweett, C. H. and D. M. Spencer. 1966. *Annals of Applied Biology* **60**:87-96.
3. Faweett, C. H. and D. M. Spencer. 1970. *Plant Chemotherapy with Natural Products* **8**:403-418.
4. Manandhar, A. 2005. *Assessment for Antifungal Activities of Plant Essential Oils Against Bipolaris sorokiniana*. M.sc dissertation. Tribhuvan University, Kathmandu, Nepal.
5. Mehrotra, R. S. and A. Aggarwal. 2003. *Plant Pathology*, Second edition, Tata Mc Graw-Hill Publishing Company Limited New Delhi 11 (263):243-265.
6. Naik, M. K. 2003. Challenges and opportunities for research in soil-borne Plant Pathogen with Special reference to *Fusarium* species. *Indian Journal of Mycology and Plant Pathology* **33** (1):1-14.
7. Pandey, B. P. 2001. *Plant Pathology: Pathogen and plant diseases*. S. Chand and Company Ltd. New Delhi. 423.
8. Parajuli, R. R., R. D. Tiwari., R. P. Chaudhary and V. N. Gupta. 2005. *Fungitoxicity of the essential oil of some aromatic plants of Manang against Alternaria brassicicola* **3**:39-43.
9. Shrestha, S. 2005. *Postharvest disease (sour rot) of Tomato (Lycopersicon esculentum) and Its Control by Some Local Plant Extracts*. M.sc dissertation. Tribhuvan University, Kathmandu, Nepal.
10. Swaminathan, M. S. 1978. Inaugural address, first Botanical Conference, Meerut India, pp.1-31.



Domestic Pig Organs as Good Sources of Nutritionally Important Fatty Acids and Low Cholesterol Meat

By E.I. Adeyeye

Ekiti State University

Abstract - The levels of fatty acids, phospholipids and zoosterols were determined in the organs of domestic pig consumed in Nigeria on dry weight basis. The organs analysed were liver, muscle and brain. Results showed crude fat varied from 2.85-4.36 g/100 g; SFA varied from 34.4 -39.9 % of total fatty acids, total unsaturated fatty acids (TUFA) varied from 60.1-65.6 %, PUFA ranged from 23.9-30.1 % and MUFA ranged from 35.5-37.7 %. PUFA/SFA range was 0.598- 0.873; EPSI range was 0.659-0.848; AA/DGLA was 6.22-20.2; n -6/ n -3 was 0.285-0.481 and EPA/DHA was 0.079-0.472. Fatty acid as food would be provided by 0.743-1.366 g/100 g (SFA); 0.796-1.239 g/100 g (MUFA); 0.574 -0.817 g/100 g (PUFA) whereas TUFA would provide 1.60-2.06 g/100 g. In energy from fatty acids: SFA would produce 27.5-50.5 kJ/100 g (34.5-39.8 %); MUFA would produce 29.5-45.8 kJ/100 g (35.5-37.7 %); PUFA would produce 21.2-30.2 kJ/100 g (23.8-30.1 %) and TUFA would produce 50.7-76.2 kJ/100 g (60.0-65.4 %). Correlation coefficient (r_{xy}) showed that liver/muscle, muscle/brain, liver/brain were each significantly different from each other at $r = 0.05$. In the phospholipids, phosphatidylcholine was mostly concentrated in all the samples having a range of 223-307 mg/100 g (58.0-63.8 %) and liver/muscle, muscle/brain and liver/brain r_{xy} were all significantly different at $r = 0.05$. Cholesterol was the only sterol with value greater than 0.00 mg/100 g or 99.996-99.997 %.

Keywords : domestic pig organs, lipid profiles, low cholesterol.

GJSFR-C Classification : FOR Code: 860109



DOMESTIC PIG ORGANS AS GOOD SOURCES OF NUTRITIONALLY IMPORTANT FATTY ACIDS AND LOW CHOLESTEROL MEAT

Strictly as per the compliance and regulations of :



Domestic Pig Organs as Good Sources of Nutritionally Important Fatty Acids and Low Cholesterol Meat

E.I. Adeyeye

Abstract - The levels of fatty acids, phospholipids and zoosterols were determined in the organs of domestic pig consumed in Nigeria on dry weight basis. The organs analysed were liver, muscle and brain. Results showed crude fat varied from 2.85-4.36 g/100 g; SFA varied from 34.4 -39.9 % of total fatty acids, total unsaturated fatty acids (TUFA) varied from 60.1-65.6 %, PUFA ranged from 23.9-30.1 % and MUFA ranged from 35.5-37.7 %. PUFA/SFA range was 0.598-0.873; EPSI range was 0.659-0.848; AA/DGLA was 6.22-20.2; *n*-6/*n*-3 was 0.285-0.481 and EPA/DHA was 0.079-0.472. Fatty acid as food would be provided by 0.743-1.366 g/100 g (SFA); 0.796-1.239 g/100 g (MUFA); 0.574 -0.817 g/100 g (PUFA) whereas TUFA would provide 1.60-2.06 g/100 g. In energy from fatty acids: SFA would produce 27.5-50.5 kJ/100 g (34.5-39.8 %); MUFA would produce 29.5-45.8 kJ/100 g (35.5-37.7 %); PUFA would produce 21.2-30.2 kJ/100 g (23.8-30.1 %) and TUFA would produce 50.7-76.2 kJ/100 g (60.0-65.4 %). Correlation coefficient (r_{xy}) showed that liver/muscle, muscle/brain, liver/brain were each significantly different from each other at $r = 0.05$. In the phospholipids, phosphatidylcholine was mostly concentrated in all the samples having a range of 223-307 mg/100 g (58.0-63.8 %) and liver/muscle, muscle/brain and liver/brain r_{xy} were all significantly different at $r = 0.05$. Cholesterol was the only sterol with value greater than 0.00 mg/100 g or 99.996-99.997 %. Chi-square analysis showed no significant difference in the cholesterol at $\alpha \leq 0.05$. Uncertainty interval percentage (UIP) was calculated where standards were available using UIP of Beef-PorkFat Blend. The two most concentrated fatty acids in liver and brain were C16:0 [24.9 % (liver) and 21.2 % (brain)], C22:6 (DHA) [19.5 % (liver) and 20.0 % (brain)]; in muscle highest concentrated fatty acids were C16:0 (23.9 %) and C18:1 (oleic acid) (15.1 %).

Keywords : domestic pig organs, lipid profiles, low cholesterol.

I. INTRODUCTION

The estimated world pig population of 826 million (FAO, 1988) means there is approximately one pig for every six people in the world. Although pigs are numerically fewer than some other domestic species, more pig meat is produced than any other meat. A comparison of the main livestock species in the world in terms of numbers and meat production is shown thus: cattle (1253), buffalo (137) (million head) have meat output (000 metric tonnes per year) as 50 098 (for the

two animals); sheep (1174), goats (521) (million head) have meat output of (8801) both animals; poultry (10050) (million head) have meat output of 11 495 whereas pigs (826) million head have meat output of 63 917 (000 metric tonnes per year (FAO, 1989).

The distribution of pigs throughout the world is not uniform. Nearly half the world's pig population is in Asia, with a further 30 per cent in Europe and the old USSR. In contrast, the population in large parts of the tropical and sub-tropical developing regions (e.g. Africa and Latin America) is relatively small. Nevertheless, the increase in the world pig population over the last decade is largely attributable to increases within the developing world which now constitutes some 60 per cent of the world population of pigs. It is noteworthy that the majority of the pigs in the developing world are located in one Asian country, namely China (Holness, 1991). Similarly, marked differences exist in the consumption patterns of pigmeat throughout the world. In some parts of Europe, annual per capita consumption of pigmeat is over 50 kg, and represents some 60 per cent of the total meat consumed. At the other end of the scale, in areas of the developing world, and particularly in Africa, estimated annual per capita consumption ranges from 1 to 3 kg, and forms less than 10 per cent of the total meat diet (Holness, 1991).

Every country has its own system of assessing the quality of the carcass and generally carcasses are graded according to a number of criteria. They include: conformation (shape of the carcass), degree of fatness (amount of fat as subcutaneous fat cover at a set position), lean content of the carcass (measurement of muscle depth in the carcass) and fat quality (carcasses that exhibit a soft and oily, rather than hard, fat cover will tend to be downgraded because they cannot be used for the higher-priced fresh meat of cured products trade) (Holness, 1991). The main products derivable from pig meat are: fresh meat, cured products (such as bacon and hams), and other processed products (such as sausages, pies, luncheon meats, hamburgers and meat pastes). Other pig products in addition to meat are: lard (pig fat), pig skin, bristles, intestines (used for sausage casings), offals (these are edible and the liver in particular is a delicacy), blood (sometimes processed into sausages and other delicacies for human consumption), slaughterhouse by-products (bones,

Author : Department of Chemistry, Ekiti State University, P.M.B. 5363, Ado-Ekiti, Nigeria. E-mails : eiadeyeye@yahoo.com, adeyeyellesanmi2012@gmail.com

blood and inedible meat tissue is converted into animal feeds) and hoofs (used for gelation and glue products) (Holness, 1991).

A pig is any of the animals in the genus *Sus*, within the Suidae family of even-toed ungulates. Pigs include the domestic pig, its ancestor the wild boar, and several other wild relatives. Young and small pigs are known as piglets (<http://www.merriam-webster.com/dictionary/piglet>). Pigs are omnivores and are highly social and intelligent animals (Angier, 2009). Scientific classification: Kingdom (Animalia), Phylum (Chordata), Class (Mammalia), Subclass (Theria), Infraclass (Eutheria), Order (Artiodactyla), Family (Suidae), Genus (*Sus* Linnaeus, 1758). The genus *Sus* is currently considered to have 10 living species and a number of extinct species known as fossils: among them is: *Sus scrofa domestica* Erxleben, 1777-Domestic pig (sometimes treated as a full species). The domestic pig (*Sus scrofa domestica*) is usually given the scientific name *Sus scrofa*, although some authors call it *S. domesticus*, reserving *S. scrofa* for the wild boar.

Meat animals yield, besides their carcasses, a considerable amount of parts which are biologically and hygienically fit for human consumption. These by-products are very different from the point of view of structure, proximate composition or functional or sensory properties, but they can all be used for food. They are generally consumed either as main ingredients in traditional dishes or as ingredients in meat products (Fornias, 1996). Among by-products which are edible are the brains which are consumed as direct meat products. People are sceptical on the consumption of pig carcass and its offals because of the believe in its high level of fat particularly saturated fatty acids and cholesterol levels. There is hardly any chemical information on the meat of domestic pig. The purpose of the present report was to explore evidence relating to the lipid composition of the muscle, liver and brain of *Sus domesticus* as contributors to the availability of long-chain (LC), very-long-chain (VLC) fatty acids and low level of sterols when taken as protein food source.

II. MATERIALS AND METHODS

a) Materials

Domestic pig (male) parts were purchased from the butchers based at Iworoko Ekiti, in Ekiti State, Nigeria. Iworoko Ekiti is less than 1.0 km north of the Ekiti State University, Ado-Ekiti. The samples were kept in freezer and brought to the laboratory within 30 min of purchase.

b) Sample Treatment

The samples were washed with distil water in the laboratory, cut into smaller bit and dried in the oven for 5 h at 60 °C. After drying, samples were ground to flour, sieved and kept in freezer (-4 °C) in McCartney bottles pending analyses.

c) Extraction of Lipid

0.25 g of each sample was weighed into the extraction thimble. 200 ml of petroleum ether (40-60 °C boiling range) was measured and then added to the dried 250 ml capacity flask. The covered porous thimble with the sample was placed in the condenser of the Soxhlet extractor arrangement that has been assembled (AOAC, 2005). The lipid was extracted for 5 h. The extraction flask with the oil was oven dried at 105 °C for 1 h. The flask containing the dried oil was cooled in the desiccator and the weight of the cooled flask with the dried oil was measured.

d) Preparation of methyl ester and analysis

50 mg of the extracted oil was saponified for 5 min at 95 °C with 3.4 ml of 0.5 M KOH in dry methanol. The mixture was neutralised by 0.7 M HCl. 3 ml of 14 % boron trifluoride in methanol was added (AOAC, 2005). The mixture was heated for 5 min at 90 °C to achieve complete methylation process. The fatty acid methyl esters were thrice extracted from the mixture with redistilled n-hexane. The content was concentrated to 1 ml for analysis and 1 µl was injected into the injection pot of the GC. The fatty acid methyl esters were analysed using an HP 5890 powered with HP gas chromatography (HP 5890 powered with HP ChemStation rev. A09.01 [1206] software [GMI, Inc, Minnesota, USA]) fitted with a flame ionization detector. Nitrogen was the carrier gas with a flow rate of 20-60 ml/min. The oven programme was: initial temperature at 60 °C, first ramping at 10 °C/min for 20 min, maintained for 4 min, second ramping at 15 °C/min for 4 min and maintained for 10 min. The injection temperature was 250 °C whilst the detector temperature was 320°C. A capillary column (30 m x 0.25 mm) packed with a polar compound (HP INNOWAX) with a diameter (0.25 µm) was used to separate the esters. Split injection type was used having a split ratio of 20:1. The peaks were identified by comparison with standard fatty acid methyl esters.

e) Sterol Analysis

Sterol was analysed as described by AOAC (2005). The aliquots of the extracted fat were added to the screw-capped test tubes. The sample was saponified at 95 °C for 30 min, using 3 ml of 10 % KOH in ethanol, to which 0.20 ml of benzene had been added to ensure miscibility. Deionised water (3 ml) was added and 2 ml of hexane was added in extracting the non-saponifiable materials. Three extractions, each with 2 ml hexane, were carried out for 1 h, 30 min and 30 min respectively. The hexane was concentrated to 1 ml in the vial for gas chromatographic analysis and 1 µl was injected into injection pot of GC. The peaks were identified by comparison with standard sterols. The sterols were analysed using similar conditions as for fatty acid methyl ester analyses.

f) *Phospholipids Analysis*

Modified method of Raheja *et al.* (1973) was employed in the analysis of phospholipids. 0.01 g of the extracted fat was added to each test tube. To ensure complete dryness of the fat for phospholipids analysis, the solvent was completely removed by passing stream of nitrogen gas on the fat. 0.40 ml chloroform was added to the tube followed by the addition of 0.10 ml chromogenic solution. The tube was heated at 100 °C in water bath for 1 min 20 sec. The content was allowed to cool to the laboratory temperature and 5 ml hexane added and the tube shaken gently several times. the solvent and the aqueous layers were allowed to be separated. The hexane layer was recovered and concentrated to 1.0 ml for analysis. The phospholipids were analysed using an HP 5890 powered with HP gas chromatograph (HP 5890 powered with HP ChemStation rev. A09.01 [1206] software [GMI, Inc, Minnesota, USA]) fitted with a pulse flame photometric detector. Nitrogen was used as the carrier gas with a flow rate of 20-60 ml/min. The oven programme was: initial temperature at 50 °C, whilst the detector temperature was 320 °C. A capillary column (30m x 0.25 mm) packed with a polar compound (HP) with a diameter (0.25 μ m) was used to separate the phospholipids. Split injection type was used having a split ratio of 20:1. The peaks were identified by comparison with standard phospholipids.

g) *Quality Assurance*

Standard chromatograms were prepared for sterols, phospholipids and fatty acid methyl esters which were then compared with respective analytical results; calibration curves were prepared for all the standard mixtures and correlation coefficient determined for each fatty acid parameter, same for sterols and phospholipids. Correlation coefficient should be > 0.95 for the result to be acceptable. It was performed with Hewlett Packard Chemistry (HPCHEM) software (GMI, Inc 6511 Bunker Lake Blvd Ramsey, Minnesota, 55303, USA).

Further on quality assurance, fatty acid values were subjected to calculation of uncertainty interval percentage (UIP). Certified reference materials (CRMs) play a critical role in validating the accuracy of nutrient data. A range of food CRMs with assigned values and uncertainty intervals (UIs) for many nutrients are currently supplied by several organisations (Phillips *et al.*, 2007). The fatty acids whose UIs were available were evaluated in certified reference materials (CRMs): C16:0, C18:0, C16:1, C18:1, C18:2 and C18:3 (AOAC, 2005; Phillips *et al.*, 2007). Certified reference material was available for cholesterol but not any of the phospholipids (Phillips *et al.*, 2007).

h) *Calculation of fatty acid as food per 100 g in sample*

At the data source and reference database levels, values for individual fatty acids are usually

expressed as percentages of total fatty acids. At the user database level, values per 100 g of food are required. A conversion factor derived from the proportion of the total lipid present as fatty acids is required for converting the percentages of total fatty acids to fatty acids per 100 g of food. Total lipid level (crude fat) was multiplied by conversion factors as follows: muscle ($3.59 \times 0.953 = 3.42$ g/100 g), brain ($4.36 \times 0.561 = 2.45$ g/100 g) and liver ($2.85 \times 0.741 = 2.11$ g/100 g) (Anderson, 1976). For fatty acids, precision is best limited to 0.1 g/100 g of fatty acids (Greenfield and Southgate, 2003).

i) *Statistical Analysis*

Statistical analysis (Oloyo, 2001) was carried out to determine coefficient of variation in per cent (CV %), linear correlation coefficient (r_{xy}), coefficient of determination (r_{xy}^2), linear regression coefficient (Rc), coefficient of alienation (C_A) and index of forecasting efficiency (IFE). The r_{xy} was subjected to the table (critical) value at $r = 0.05$ to see if significant differences existed in the values of fatty acids and phospholipids in the samples having a mapping of liver/muscle, muscle/brain and liver/brain. The cholesterol was subjected to chi-square (X^2) analysis as well setting the critical value at $\alpha \leq 0.05$.

III. RESULTS AND DISCUSSION

Table 1 depicts the crude fat levels of the samples. Also shown are the true total fatty acids and the energy (kJ/100 g) of each sample. The liver had the least crude fat of 2.85 g/100 g whereas brain had the highest level of 4.36 g/100 g; the true total fatty acids and total energy followed this trend. The coefficient of variation per cent (CV %) was low showing the fat levels were generally close among the values. From Fornias (1996) the percentage fat levels of the samples: brain (9.2), liver (2.4), lean pork (5.9) with corresponding energy value (Cal) of: 127, 116 and 143. In the bull, the crude fat was 42.5 g/100 g (brain) and total fatty acid (23.8 g/100 g) whereas in the hen, brain crude fat was 45.2 g/100 g and true total fatty acid of 25.4 g/100 g (Adeyeye, 2012a). The low level of fat (and low energy) from pork is a benefit to the consumer. Although pork contains a high concentration of nutrients, lean pork is relatively low in calories and of the major meats only chicken has a lower calorific value as shown (Holness, 1991): number of calories per 85 g of lean: beef (228), lamb (221), liver (220), pork (206) and chicken (144). This allows for a higher intake of the energy-rich, bulkier foods to be enjoyed. These considerations particularly apply to consumers in the developed world, but there is an increasing trend for consumers in the developing world, especially in urban and peri-urban areas, to become more aware of the need to reduce fat in the human diet (Holness, 1991).

We have in Table 2 the various levels of saturated and monounsaturated fatty acids (SFA and MUFA). Short-chain (SC) fatty acids (C4-C6) had no good values in all the samples. Medium-chain (MC) fatty acids (C8-C12) were detected in the samples particularly in the muscle. The values were however low where present. Both liver and brain had values only for C12:0 whereas muscle had value for C8:0, C10:0 and C12:0. The CV % in C8:0 and C10:0 were high at 173 whereas it was low in C12:0 with a value of 26.1. C8:0-C12:0 have antimicrobial properties, are absorbed directly for quick energy and contribute to the health of the immune system (Enig and Fallon, 2000). The long-chain (LC) fatty acids have from 14 to 18 carbon atoms and can be either saturated, monounsaturated or polyunsaturated.

The first member of LC is C14:0, it is a ubiquitous component of lipids in most living organisms but usually at levels of 1-2 % only. In the present samples it has values of 2.23-4.97 % with a CV % of 46.1. Nutmeg butter is 75 % trimyristin, the triglyceride of myristic acid. Besides nutmeg, myristic acid is also found in palm kernel oil, coconut oil, butter fat and is a minor component of many other animal fats (IUPAC, 2001). It is also found in spermaceti, the crystallized fraction of oil from the sperm whale. Myristic acid is also commonly added co-transnationally to the penultimate, nitrogen-terminus, glycine in receptor-associated kinases to confer the membrane localisation of the enzyme. The myristic acid has a sufficiently high hydrophobicity to become incorporated into fatty acyl core of the phospholipid bilayer of the plasma membrane of the eukaryotic cell. In this way, myristic acid acts as a lipid anchor in biomembranes. The ester isopropyl myristate is used in cosmetic and tropical medicinal preparations where good absorption through the skin is desired. Palmitic acid (16:0) is usually considered the most abundant SFA in nature, it is found in appreciable amounts in the lipids of animals, plants and lower organisms. It comprises 20-30 % of the lipids in most animal tissues and it is present in amounts that vary from 10 to 40 % in seed oils. The present results of 21.2-24.9 % are within the range of 20-30 % of the lipids in most animal tissues. The bull's head and chicken head brains contained no detectable level of C16:0 (Adeyeye, 2012a). Stearic acid (18:0) is the second most abundant SFA in nature, and again it is found in the lipids of most living organisms. In these samples (18:0) occupied the second highest position in the SFA with values of 7.70-10.4 % with a CV % of 16.1. In lipid of some commercial importance, it occurs in the highest concentrations in ruminant fats (milk and tallow) or in vegetable oils such as cocoa butter, and in industrially hydrogenated fats. It can comprise 80 % of the total fatty acids in ganliosides. The other SFAs present in minor levels were arachidic acid (C20:0, 0.026-1.93 %), behenic acid (C22:0, 0.019-0.043 %) and lignoceric acid

(C24:0, 0.002-0.005 %). The total SFA of 34.4-39.9 could easily compare favourably with literature values; they are: 43 % (beef fat), 50 % (lamb fat), 37 % (pork fat), 33 % (chicken, meat and skin), 27 % (duck, meat and skin), 30 % (calf liver) (Bender, 1992); three different land snails consumed in Nigeria (37.5-49.8 %) (Adeyeye, 2012b); bush pig (*Potamochoerus larvatus*) having SFA values of 39.5-47.6 % (Adeyeye *et al.*, 2013).

Oleic acid [9c-18:1 or 18:1(*n*-9)] is by far the most abundant monoenoic fatty acid in plant and animal tissues, both in structural lipids and in depot fats. It is the highest concentrated MUFA in muscle (15.1%) but second in liver (12.0 %) and brain (10.0 %). Olive oil contains up to 78 % oleic acid, and it is believed to have especially valuable nutritional properties as part of the Mediterranean diet. It has a number of important biological properties, both in the free and esterified form. Oleic acid is the biosynthetic precursor of a family of fatty acid with the (*n*-9) terminal structure and with chain-lengths of 20-24 or more. Petroselinic acid (6c-18:1) occurs up to a level of 50 % or more in seed oils of Umbelliferae family, including carrot, parsley and coriander. In the present report, petroselinic acid occupied the highest position in the *cis*-18:1 FA in both liver (12.5 %) and brain (13.7 %) but second highest in muscle (8.64 %). Studies in vitro by Weber *et al.* (1995) revealed that triacylglycerols containing petroselinoyl [18:1(*n*-12)] moieties are hydrolysed by pancreatic lipase at much lower rates than other triacylglycerols. Consumption of coriander (*Coriandrum sativum*) oil, compared with the other oils, led to significantly greater liver weights. No significant differences were observed among the groups fed various levels of oleic acid in body weight, the weights of heart, liver, kidneys, spleen or testes, lipid content of heart, or total cholesterol, HDL cholesterol and triacylglycerol concentrations of blood plasma. Ingestion of coriander oil led to incorporation of 18:1 (*n*-12) into heart, liver and blood lipids and to a significant reduction in the concentration of arachidonic acid in the lipids of hearts, liver and blood with a concomitant increase in the concentration of linoleic acid compared with results for the other groups. The data show that petroselinic acid from dietary triacylglycerols is absorbed by rats as readily as oleic acid, but the former reduces the concentration of arachidonic acid in tissue lipids suggests [in view of earlier studies (Mohrhauer *et al.*, 1967)] petroselinic acid-mediated inhibition of arachidonic acid synthesis. Another MUFA of reasonable level is palmitoleic acid (C16:1 c-9) having values of 6.39-6.95 % and CV % of 4.37. C 16:1c-9 has strong antimicrobial properties and it is found almost exclusively in animal fats (Enig and Fallon, 2000). It is also found in rich amounts in macadamia nut, olive, canola and peanut oils. This monounsaturated fatty acid is beneficial in reducing bad cholesterol (LDL) and it behaves like a saturated and not as an unsaturated fatty acid in its effect on HDL

cholesterol (Nestel *et al.*, 1994). It also reduces the fat deposition in blood vessels and reduces blood clot formation (Grundy, 1994). Gondoic acid [11-*cis*-eicosenoic acid (11-20:1 or 20:1(*n*-9))] is a common if minor constituent of animal tissues and fish oils, often accompanied by the 13-isomer. It is also found in rapeseed oil and seed oils of related species. Its value ranged from 4.15-4.87 % and CV % of 9.26 in the present samples. Erucic acid (C22:1 *cis*-13) is a fatty acid that is apparently responsible for a favourable response of persons with nervous system disorders (Christensen *et al.*, 1988). The administration of erucic acid in the diet will reduce the serum levels and brain accumulation of very-long-chain of saturated fatty acids (such as C26:0) responsible for demyelination (Sargent *et al.*, 1994; Rasmussen *et al.*, 1994). The level of erucic acid in the present samples ranged from 1.19-1.46 % and CV % of 10.2.

Accumulation of certain long-chain fatty acids is associated with degenerative diseases of the central nervous system, such as behenic acid (C22:0; 0.019-0.043 % in samples) but about 1 % in beef fat [Whetsell *et al.*, 2003] and lignoceric acid (C24:0; 0.002-0.005 % in samples but about 1 % in beef fat) as well as that of the unsaturated members of C22 and C24 group (Whetsell *et al.*, 2003). Accumulation occurs because enzymes needed to maintain turnover of those fatty acids are lacking (Lord and Bralovey, 2001). Behenic acid has been detected to be a cholesterol-raising SFA factor in humans (Cater and Denke, 2001).

The total *trans*-MUFA concentration was very low and insignificant at 0.008-0.018 % with CV % of 44.1 whereas *cis*-MUFA total ranged from 35.5-36.2 % and CV % of 3.06.

In Table 3 were enumerated the various concentrations of PUFA *n*-6 and *n*-3 fatty acids. The Table contains both long-chain (LC) and very long-chain (VLC) fatty acids (LC, 18 and VLC, 20-24) carbon atoms. The major important polyunsaturated fatty acids found in samples were linoleic acid (LA) (C18:2 *cis*-9, 12), arachidonic acid (AA) (C20: 4 *cis*-5, 8, 11, 14), alpha-linolenic acid (ALA) (C18:3 *cis* -9, 12, 15), eicosapentaenoic acid (EPA) (C20:5 *cis*-5, 8, 11, 14, 17) and docosahexaenoic acid (DHA) (C22:6 *cis*-4, 7, 10, 13, 16, 19). LA had values of 0.760-1.87 % and CV % of 47.1; AA had 2.21-6.79 % and CV % of 50.7; ALA had 0.024-0.629 % and CV % of 148; EPA had 1.55-4.96 % and CV % of 70.1 and DHA had 10.5-20.0 % with CV % of 32.1. Alpha-linolenic acid (C18:3) is classified as a short-chain omega-3 fatty acid and is also found in nuts and seeds. Eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are found predominantly in foods of marine origin and are classified as long-chain omega-3 fatty acids. LA is also found in corn, sunflower oil, safflower oil and soybeans whereas AA is found in brain, liver, glandular and egg lipids (both acids

belong to the omega-6 family of fatty acids) (Whetsell *et al.*, 2003).

The omega-3 fatty acids present in pastures, like the alpha-linolenic acid (C18:3), appear to have little direct value for human health. However, the human body can add 2 or 4 carbons to these 18-carbon chain fats to produce 20-or 22-carbon chain omega-3 fatty acid. Thus, alpha-linolenic acid (C18:3) is a pre-cursor for EPA (C20:5) and DHA (C22:6) fatty acids, which are important for human health. It has been suggested that alpha -linolenic acid has a beneficial effect on cardiovascular heart disease (Ascherio *et al.*, 1999; Hu *et al.*, 1999). However, other studies reported no evidence of alpha-linolenic acid having a positive effect on cardiovascular heart disease (Renaud and Lanzmann-Petitthory, 2002; Sanderson *et al.*, 2002). Although alpha-linolenic acid supplementation causes an increase in the blood and plasma levels of alpha-linolenic acid, EPA and DPA, no benefit has shown on either risk factors for cardiovascular diseases or on secondary prevention of cardiovascular heart disease (Sanderson *et al.*, 2002). The present results do not appreciate the essentiality of C18:3 since both EPA and DHA were already much in excess of the C18:3 in the primary samples.

For many years linoleic acid (C18:2; omega-6) was thought to be the preferable fatty acid for the diet because it was considered to be the most effective cholesterol-lowering fatty acid. However, despite an increase in linoleic acid intake (from about 4 % to 7 %), there has been a growing reservation about recommending its consumption, due to no proven long-term safety (Grundy, 1994). In humans, high supplemental intakes of linoleic fatty acid can lower good cholesterol concentration and may increase the risk for cholesterol gallstones. In addition, the presence of linoleic acid in bad cholesterol lipids makes them more prone to oxidation, which could promote atherosclerosis. Because of these detrimental effects, current recommendations have been moderated and now caution that intakes of this fatty acid should not exceed current concentrations (about 7 % of total energy intakes; present result is very much below this level) (Grundy, 1994). However, recent information from American Heart Association (Whetsell *et al.*, 2003) indicates that linoleic acid has a noticeable effect on lowering cholesterol further than oleic and palmitic acids when plasma cholesterol levels are high (> 200 mg/dl). They suggest that a 10 % calorie intake in the form of polyunsaturated fats, linoleic acid achieves a maximal effect on cholesterol lowering. It also has been suggested (Iso *et al.*, 2002) that a higher intake of linoleic acid appear to protect against stroke, possibly through potential mechanism of decreased blood pressure, reduced platelet aggregation and enhance deformability of erythrocyte cells. Again high levels of

arachidonic acid might have reduced the essentiality of linoleic acid in the samples.

Linoleic acid and alpha-linolenic acid are plant fatty acids that can be transformed to CLA (conjugate linolenic acid) by bacteria in the rumen, hence rumenic acid (Kepler *et al.*, 1966). They are the C18:2 *cis*-9, *trans*-11 (just one of the series). A lot of health benefits have been attributed to CLA (Kramer, 1998), this includes its behaviour as an antioxidant, it also reduces circulating cholesterol in mice (West *et al.*, 1998). CLA in the samples was low at 0.011-0.090 % and CV % of 108.

It has been suggested that arachidonic acid (C20:4 *cis*-5, 8, 11, 14) is detrimental to human health (Barham *et al.*, 2000). However, it promotes inflammation that is an important protective response when one is injured. It also forms the basis of anti-inflammatory prostaglandins that the body uses, to reduce inflammation (Fallon and Enig, 1996). The amount of arachidonic acid in beef is very low (less than 0.5 % of total fat); it is much higher in the domestic pig: 2.21- 6.79 % of total fatty acids.

Two other omega-3 fatty acids in the samples are DHA (C22:6) and EPA (C20:5), have been reported to have health benefits (Mantzioris *et al.*, 2000). These omega-3 fatty acids have been shown to prevent cancer (Hardman, 2002), and cardiovascular disease (Simopoulos, 2002), as well as being therapeutic for arthritis (Kremer, 2000), autoimmune disease (Harbige and Fisher, 2001), inflammatory effects (Grimm *et al.*, 2002) and depression (Puri *et al.*, 2001). DHA is also important during pregnancy for infant and brain development (Horrocks and Yeo, 1999) and reduces the incidence of premature birth (Allen and Harris, 2001). EPA lowers blood cholesterol (Pal *et al.*, 2002) and reduces blood clotting, allowing better blood circulation (Heller *et al.*, 2002). The present samples have high levels of EPA and DHA with respective values of 1.55-4.96 % and 10.0-20.0 %. Thus, there is a benefit from the production of additional DHA and EPA by the body's elongation and desaturation of shorter chain fatty acids (C18:3 omega-3; 18:2 omega -6) in humans. Total PUFA in the samples ranged as 23.9-30.1 %; in the bull and hen brain it was 83.5-85.0 % (Adeyeye, 2012a); in three land snails it was 25.5-38.7 % (Adeyeye, 2012b); in the bush pig it was 18.9-23.1 % (Adeyeye *et al.*, 2013).

Table 4 contains the summary of quality characteristics of the fatty acids profile. The relative values of PUFA in all the samples made them important in diet. The eicosanoids help regulate blood clot formation, blood pressure, blood lipid (including cholesterol) concentration, the immune response, the inflammation response to injury and infection and many other body functions (Whitney *et al.*, 1994). A deficiency of *n*-6 fatty acids in the diet leads to skin lesions. A deficiency of *n*-3 fatty acids leads to subtle neurological and visual problems. Deficiencies in PUFA produce growth retardation, reproductive failure, skin

abnormalities and kidney and liver disorders. However, people are rarely deficient in those fatty acids (Tapiero *et al.*, 2002). The relative amounts of PUFA and SFA in oils is important in nutrition and health. The ratio of PUFA/SFA (P/S ratio) is therefore important in determining the detrimental effects of dietary fats. The higher the P/S ratio the more nutritionally useful is the oil. This is because the severity of atherosclerosis is closely associated with the proportion of the total energy supplied by SFA and PUFA fats (Honatra, 1974). The present PUFA/SFA varied between 0.598-0.873 which were averagely normal. The *n*-6 and *n*-3 FAs have critical roles in the membrane structure (Kinsella, 1990) and as precursors of eicosanoids, which are potent and highly reactive compounds. Since they compete for the same enzymes and have different biological roles, the balance between the *n*-6 and *n*-3 FAs in the diet can be of considerable importance (WHO/FAO, 1994). The ratio of *n*-6 to *n*-3 or specifically LA to ALA in the diet should be between 5:1 and 10:1 (WHO/FAO, 1994) or 4-10 g of *n*-6 FAs to 1.0 g of *n*-3 FAs (Canadian Government Publishing Center, 1990). As LA is almost always present in foods, it tends to be relatively more abundant in animal tissues. This is supported in the present report as follows: C18:2 (*n*-6) ranged as 0.760-1.87 % whereas C18:3 (*n*-3) ranged as 0.024-0.629 %. In turn, these FAs are the biosynthetic precursors in animal systems of C20 and C22 PUFAs, with 3-6 double bonds, via sequential desaturation and chain-elongation steps (desaturases in animal tissues can only insert a double bond) (Berg *et al.*, 2007). Looking at *n*-6/*n*-3 in Table 4, none of the samples fell within the expected ratio, we had 0.285:1 to 0.481:1 and in LA/ALA, we had 2.98:1 to 31.7:1 ratios. Both LA and ALA need adjustment from other food sources.

The relative proportion of MUFA/SFA is an important aspect of phospholipid compositions and changes to this ratio have been claimed to have effects on such disease states as cardiovascular disease, obesity, diabetes, neuropathological conditions and cancer. For example, they have been shown to have cyto-protective actions in pancreatic β -cells. *Cis*-Monoenoic acids have desirable physical properties for membrane lipids in that they are liquid at body temperature, yet are relatively resistant to oxidation. They are now recognised by nutritionists as being beneficial in the human diet (Adeyeye, 2012b). Present results gave values of MUFA/SFA as 0.908-1.07 (Table 4) which were good enough. A high ratio between AA and DGLA, as an indicator of Δ -5 desaturase activity, in the skeletal muscle phospholipids has been related to good insulin sensitivity; the AA/DGLA in the samples ranged as 6.22-20.2 (Table 4) which were good results. For the assessment of the essential PUFA status of an individual, the total amount of the various EFA and PUFA in plasma or erythrocyte phospholipids is a useful indicator (Hornstra, 1992). The following are further used

as additional status markers to reliably assess the functional PUFA status (Benatti *et al.*, 2004). The best known marker is Mead acid [trivial name for all-*cis*-icosa-5, 8, 11-trienoic acid (20:3 ω -9)]. The synthesis of this fatty acid is promoted if there are insufficient concentrations of LA and ALA to meet the need for the synthesis of long-chain PUFA. EPA and DHA inhibit Mead acid synthesis; the presence of Mead acid indicates a general shortage of all essential PUFA. The present results had ratios of EPA/DHA as 0.079-0.472 and no Mead acid was produced. Another suitable indicator of essential PUFA status is the essential PUFA status index (EPSI), which is the ratio between all essential PUFA (the sum of all ω -3 and ω -6 FAs) and all non-essential unsaturated FAs (the sum of all ω -7 and ω -9 FAs). The higher the EPSI status indexes the better the essential PUFA status. The present results had values of EPSI range of 0.659-0.948 which were all above average. Finally, if there is a functional shortage of DHA, the body starts to synthesize the most comparable long-chain PUFA of the ω -6 family, osbond acid (C22:5 ω -6). Therefore, under steady state conditions, the ratio between DHA and osbond acid is a reliable indicator of the functional DHA status (Neuringer *et al.*, 1986). Hence the PUFA in the domestic pig samples cannot cause functional distress.

Table 5 contains the fatty acids distribution per 100 g sample as food. The values produced from SFA, MUFA and PUFA were consistently highest in the pig muscle than the corresponding two other samples. In the ω -6 values were highest in AA > LA; in ω -3 values were highest in DHA > EPA. The calculation accounted for all the total fatty acids as calculated by crude fat x the conversion factors for samples.

The National Institute of Health has published recommended daily intakes of FAs; specific recommendations included 650 mg of EPA and DHA, 2.22 g/day of ALA and 4.44 g/day of LA. However, the Institute of Medicine has recommended DRI (dietary reference intake) for LA at 12 to 17 and ALA at 1.1 to 1.6 g for adult women and men, respectively. Although seafood is the major dietary source of ω -3 FAs, a recent fatty acid intake survey indicated that red meat also serves as a significant source of ω -3 fatty acids for some population (Daley *et al.*, 2010); this had been aptly demonstrated in the pig samples.

The PUFA content of some selected foods for LA are (mg/100 g): beef (muscles only), 80; calf's kidney, 61; chicken (breast), 980; chicken (leg), 370; horse meat (average), 160; pork (muscle only), 110; turkey (breast), 180; turkey (leg), 750; veal (muscles only), 197. For ALA (mg/100 g): calf's kidney, 61; chicken (breast), 2.7; chicken (leg), 10; horse meat (average), 260; pork (muscle only), 25 and veal (muscles only), 9.1 (Souci *et al.*, 1990). The present level of LA and ALA are in good relationship with the literature

values having values of 127-266 mg/100 g (linoleic acid) and 447-533 mg/100 g (alpha linolenic acid).

The energy in food is held in form of fat, carbohydrate, protein and alcohol. Each gram of fat contains approximately 9 kilocalories (37 kJ) (Royal Society, 1972). This value was used to calculate the energy levels of the various fat samples. The energy density in the samples due to fat ranged as 78.2-127 kJ/100 g (about 19.0-30.8 kcal/100 g) (Table 6). The 1990 Canadian RNI (Recommended Nutrient Intakes) included specific amounts for 3 ω -3 fatty acids and 2 ω -6 fatty acids. For ω -3 FAs, the RNI is 0.5 % of total energy or 0.55 g/1000 kcal; for ω -6 FAs, the RNI is 3 % of total energy or 3.3 g/1000 kcal (Whitney *et al.*, 1994). For energy contribution in the samples, the following was observed: liver (MUFA > SFA > PUFA), muscle (SFA > MUFA > PUFA), brain (MUFA > SFA > PUFA).

Remember, total energy contribution by the samples ranged from 78.2-127 kJ/100 g (about 19.0-30.8 kcal/100 g). For optimum weight loss, reduce your overall fat/oil consumption to a sensible level. A level of 15-20 % of your total calories should come from fat-and the majority of that should be essential fatty acids. To determine how many grams of fats this translates into, you multiply your total daily calories by 15 % (20 % for the high-end of the range) and then divide by 9, which is the number of calories in a gram of fat. Here is an example: 2500 daily calories x 0.15 = 375/9 = 41.7 or 42 g of total fat per day- the bulk of which should be EFAs. It is known that 20 % energy from fat is consistent with good health. With 41.7 g of total fat per day, the pig that contains 2.11-3.42 g/100 g fatty acids will only be able to be a minor source of energy to its consumers.

The statistical analysis of the results in Table 4 is shown in Table 7. Results showed high positive and significant linear correlation coefficient (r_{xy}) (0.8060-0.9874) at $r_{=0.05}$ and $n-2$ degrees of freedom. The coefficient of determination (r_{xy}^2) values were also high (0.6500-0.9745) showing that 65.00-97.45 % of variance in liver/muscle (76.38 %), muscle/brain (65.00 %) and liver/brain (97.45 %). The linear regression (Rc) showed that for every unit increase in the liver fatty acid, there was a corresponding increase of 1.34 in the fatty acid of muscle; a unit increase in muscle resulted into 5.99 increase in brain fatty acid and a unit increase in liver resulted into 0.7475 increase in brain fatty acid. The coefficient of alienation (C_A) values ranged as 0.1585 (15.85 %)- 0.4860 (48.60 %) with corresponding high values of index of forecasting efficiency (IFE) with values of 0.5140 (51.40 %)-0.8415 (84.15 %). The IFE is actually a value of reduction of error of relationship between the compared paired samples; this meant that the error in the prediction of relationship was 48.6 % (liver/muscle), 35.0 % (muscle/brain) and 15.85 % (liver/brain). The implication of this was that any member of a pair in each group fatty acids could carry out adequately the functions of the other pair of its group.

The pig samples demonstrated close values of phospholipids with levels ranging from 352-529 mg/100 g at low CV % of 22.1 as shown in Table 8. Mammalian cell membranes contain more than a thousand different phospholipids. This large mixture of phospholipid species is primarily the result of the distinct fatty acyl chains esterified to the sn-1 and sn-2 positions of the glycerol backbone as well as the different polar head-groups attached to the sn-3 position of the glycerol backbone. The amounts of the various phospholipids in a membrane define the fluidity of the membrane and, consequently, the functions of the embedded proteins (Vance, 2008). Phosphatidylcholine is the most abundant phospholipid in mammalian cell membranes, comprising 40-50 % of total phospholipids. In the present results, phosphatidylcholine (lecithin) values ranged as 223-307 mg/100 g or 58.0 -63.8 %. The second most abundant mammalian membrane phospholipid is phosphatidylethanolamine (PE or cephalin) which comprises 20-50 % of total phospholipids. This is true in the present results with values ranging from 95.7-133 mg/100 g or 24.7-27.2 %. In the brain, ~ 45 % of total phospholipids are PE whereas in the liver only ~ 20 % of total phospholipids are PE (Vance, 2008). In the present report, PE in brain was 25.1 % and PE in liver was 27.2 %. Phosphatidylserine (PS) is a quantitatively minor membrane phospholipid that makes up 2-10 % of total phospholipids (Vance, 2008). PS came 4th in position among the phospholipids in all the samples and had values of 12.9-33.6 mg/100 g or 3.66-6.35 %. There is a strong metabolic inter-relationships among PS, PE and phosphatidylcholine (Vance, 2008). Additional relatively minor mammalian membrane phospholipids include phosphatidylinositol [PI, 3rd position, 17.4-37.2 mg/100 g (4.94-7.01 %)] and lysophosphatidylcholine [5th position, 3.68-18.0 mg/100 g (1.05-3.40 %)].

Different types of mammalian cells and tissues have characteristic phospholipid compositions. For example, the brain is enriched in the two aminophospholipids PE and PS compared to other tissues (Vance, 2008). In the present results PE in brain to PE in muscle and liver had ratios of 1.39:1 and 1.39:1 respectively; in PS brain to PS muscle and liver, we had 2.24:1 (muscle) and 2.60:1 (liver). In the brain, and particularly in the retina (Ford *et al.*, 2007), the acyl chains of PS are highly enriched in docosahexaenoic acid (22:6 ω -3) (Kim, 2007). In human grey matter, 22:6 ω -3 accounts for > 36 % of the fatty acyl species of PS (Kim *et al.*, 2004). Since 22:6 ω -3 appears to be essential for normal development and functioning of the nervous system (Mozzi *et al.*, 2003) it is likely that PS plays an important role in the nervous system and in vision (Kim, 2007).

Phospholipids were, for many years, thought to play primarily structural roles in biological membranes. A large number of recent studies have revealed, however,

that these lipids mediate important regulatory functions in cells, partly because of their ability to be converted into key lipid second messengers such as diacylglycerol, inositol-1, 4, 5-trisphosphate (Berridge and Irvine, 1984; Nishizuka, 1986), lyso-phosphatidic acid and arachidonic acid.

The statistical analysis of the results in Table 8 is depicted in Table 9. These values were high in the pairwise comparisons: r_{xy} (0.9985-0.9996, all values significant), r_{xy}^2 (0.9971-0.9992), Rc (0.4936-13.5) and IFE (0.9459-0.9711 or 94.59-97.11 %); but the C_A was low (0.0289-0.0541 or 2.89-5.41 %).

In the analysis of sterols, only cholesterol had values greater 0.00 mg/100 g. Those outside the range of 0.00 mg/100 g were cholestanol, ergosterol, campesterol, stigmasterol, 5-avenasterol and sitosterol as shown in Table 10. The only major sterol of concern was cholesterol whose values ranged from 50.7-89.3 mg/100 g forming percentage range of 99.996-99.997 %. The CV % for cholesterol was 31.1. Cholesterol is a fatty compound involved in the transport of fat in the blood stream and is also part of the structure of cell membranes of tissues of the body. It is not a dietary essential since adequate amounts are synthesised in the body from other dietary ingredients. The body makes one-eighth to one-fourth teaspoons of pure cholesterol daily. Confusion has arisen between the terms blood cholesterol and dietary cholesterol. For most individuals dietary cholesterol has little or no effect on blood cholesterol because reduced synthesis in the body compensates for increased dietary intake (Bender, 1992). However, there are individuals who are sensitive to dietary cholesterol (Reiser and Shorland, 1990) and most authorities advise a general reduction in cholesterol intake for everyone. The rise of cholesterol in the body can give a condition in which excessive cholesterol is deposited in artery walls called atherosclerosis. This condition blocks the blood flow to vital organs which can result in high blood pressure or stroke. Cholesterol in foods is not always bad, there are some types of cholesterol which are friendly to the heart and blood vessels. High-density lipoprotein is commonly called the "good" part of cholesterol. These lipoproteins help in the removal of cholesterol from the cells, which are then transported back to the liver where it is disintegrated and excreted as waste or broken down into parts (Cholesterol Advise. Net Understanding Cholesterol: What is Cholesterol and Causes High Cholesterol?).

Meat supplies about one third of the dietary cholesterol in many western diets with the remainder from eggs and dairy products. Since all these foods are valuable sources of nutrients there could be some nutritional risk in restricting their intake. Most authorities, but not all, recommend a reduction in dietary cholesterol to around 300 mg or less per day (Bender, 1992); this is more than the level in 100 g in the samples under

discussion. Some literature values of cholesterol are as shown (mg/100 g): fish (50-60), egg yolk (1260), meat and poultry (60-120), brain (2000-3000), liver (300-350) (Bender, 1992). Sheep brain contains 2200 mg/100 g cholesterol level (Paul and Southgate, 1978). Garcia *et al.* (2008) reported (cholesterol/100 g) 40.3 and 45.8 or 40300 and 45800 mg/100 g of tissue in pastured and grain-fed steers (castrated bulls), respectively ($p < 0.001$). Levels (mg/100 g) in bull brain was 874 and in hen brain it was 589 (Adeyeye, 2012a). In bush pig it ranged from 316-383 mg/100 g (Adeyeye *et al.*, 2013).

Table 11 shows the uncertainty interval per cent (UIP) for fatty acids and cholesterol. Most of the literature UIP levels were correspondingly lower than the present results in most of the samples. The only exception was in C16:1 where critical UIP was 6.2 whereas sample UIPs ranged from 2.30-2.50. Beef-PorkFat Blend UIP information was used in comparing to the domestic pig values. The implication of the UIP values on the present result is that higher critical (table value) for fat/cholesterol than the present result values means that the new IUP in the sample result is higher than the critical table value. For example, $UIP = (UI/value) \times 100$ in C16:0; we have 25.96 (0.3, 1.2); where 0.3 is UI, 25.96 is sample value and 1.2 is UIP; hence $0.3/25.96 \times 100 = 1.2$. On the other hand where standard value was less than experimental result, then experimental UIP is lower like in C16:1 (where standard sample value was 2.58). UIP determination is one of the ingredients to attest to the quality of the analytical determinations. Also the correlation determined for all the standards: fatty acids, phospholipids and sterols, all had values ranging as follows: 0.99833-0.99997 (fatty acids), 0.99909-0.99999 (phospholipids) and 0.99920-0.99994 (sterols); all the correlation values were greater than 0.95 which is the least critical correlation for acceptance of these types of analytical results. Both the correlation values and UIP values attested to the quality of the determinations.

IV. CONCLUSION

Sus scrofa domesticus organs (liver, muscle, brain) are sources of low level of fats which are mostly unsaturated which might not promote cardiovascular disease. The fatty acids are also high in the essential fatty acids particularly arachidonic and docosahexaenoic acids. All the samples were good sources of phospholipids and they all contain low cholesterol as the only major sterol. For people on low fat animal protein food source, the domestic pig is recommended as their animal protein choice.

REFERENCES RÉFÉRENCES REFERENCIAS

- Adeyeye, E.I. (2012a). Study of long-chain n -6 and n -3 polyunsaturated fatty acids and other lipids in brains of bull and hen. *Elixir Food Science*, 47, 8599-8606.
- Adeyeye, E.I. (2012b). Lipid composition of three different types of land snails consumed in Nigeria. *Global Journal of Science Frontier Research Chemistry*, vol. 12(7), version 1.0, 8-22.
- Adeyeye, E.I.; Adesina, A.J.; Aladegbemi, A.A. (2013). Fatty acids, phospholipids and zoosterols levels of the muscle, skin and liver of bushpig (*Potamochoerus larvatus*): dietary implications. *International Journal of Advanced and Innovative Research*, vol. 2(1), 65-90.
- Anderson. B.A. (1976). Comprehensive evaluation of fatty acids in foods. VII. Pork products. *Journal of the American Dietetic Association*, 69, 44-49.
- Angier, N. (2009). Pigs prove to be smart, if not vain. (<http://www.nytimes.com/2009/11/10/science/10angier.html>). *The New York Times*.
- Alien, K.G.; Harris, M.A. (2001). The role of n -3 fatty acids in gestation and parturition. *Exp. Biol. Med.* (Maywood), 226(6), 498-506.
- Ascherio, A. (1999). Epidemiologic studies on dietary fats and coronary heart disease. *American Journal of Medicine*, 113 (suppl.) 9B, 9S-12S.
- AOAC (2005). *Official methods of analysis* (18thed.). Washington DC, USA: Association of Analytical Chemists.
- Barham, J.B.; Edens, M.B.; Fonteh, A.N.; Johnson, M.M.; Easter, L.; Chilton, F.H. (2000). Addition of eicosaentanoic acid to γ -linolenic acid-supplemented diets prevents serum arachidonic acid accumulation in humans. *Journal of Nutrition*, 130, 1925-1931.
- Banatti, P.; Peluso, G.; Nicolai, R.; Calvani, M. (2004). Polyunsaturated fatty acids: biochemical, nutritional and epigenetic properties. *J. Am. Coll. Nutr.*, 33 (4), 281-302.
- Bender, A. (1992). *Meat and meat products in human nutrition in developing countries*. FAO Nutrition Paper 53. Rome: FAO.
- Berg, J.M.; John, L.; Typoczko, L.; Lubert, S. (2007). *Biochemistry* (6thed.). New York: W.A. Freeman and Company.
- Berridge, M.J.; Irvine, R.F. (1984). Inositol trisphosphate, a novel second messenger in cellular signal transduction. *Nature*, 312, 315-321.
- Canadian Government Publishing Center (1990). *Nutrition Recommendations: The report of the Scientific Review Committee*. Ottawa, Canada: Canadian Government Publishing Center.
- Cater, N.B.; Denke, M.A. (2001). Behenic acid is a cholesterol-raising saturated fatty acid in humans. *American Journal of Clinical Nutrition*, 73(1), 41-44.
- Christensen, E.; Hagve, T.A.; Christophersen, B.O. (1988). The Zellweger syndrome: deficient chain-shortening of erucic acid [22:1 (n-9)]. *Biochemistry Biophysical Acta*, 959(2): 134-142.

17. Enig, M.G.; Fallon, S. (2000). The truth about saturated fats. (Proven Health Benefits of Saturated Fats.) From: *Nourishing traditions: the cookbook that challenges politically correct nutrition and the diet dictocrats* by Fallon S. with Enig M.G. (New Trends Publishing 2000, www.newtrendspublishing.com 877-707-1776), pp.1-39.
18. Daley, C.A.; Abbott, A.; Dowie, P.S.; Nader, G.A.; Larson, S. (2010). Grass fed versus grain fed beef: fatty acid profiles, antioxidant content and taste. *Nutrition Journal*, 9,10-21.
19. Fallon S.; Enig, M.G. (1996).Tripping lightly down the prostaglandin pathways. *Price-Pottenger Nutr. Foundation Health Journal*, 20(3), 5-8 and on www.WestonAPrice.org
20. FAO (1988.1989).*Quarterly Bulletins of Statistics*. Rome: FAO.
21. Ford, D.A.; Monda, J.K.; Brush, R.S.; Anderson; R.E.; Richards, M.J.; Fliesler, S.J.(2008). Lipidomic analysis of the retina in a rat model of Smith-Lemli-Opitz Syndrome: alterations in docosahexanoic acid content of phospholipid molecular species. *J. Neurochem.*, 105(3), 1032-1047.
22. Fornias, C.V. (1996). *Edible by-products of slaughter animals*. FAO Animal Production and Health Paper 123. Rome, Italy: FAO.
23. Garcia, P.T.; Pensel, N.A.; Sancho, A.M.; Latimori, N.J.; Kloster, A.M.; Amigone, M.A.; Casal, J.J. (2008). Beef lipids in relation to animal breed and nutrition in Argentina. *Meat Science*, 79, 500-508.
24. Greenfield, H.; Southgate, D.A.T. (2003). *Food composition data, production, management and use*. Rome, Italy: FAO.
25. Grimm, H.; Mayer, K.; Mayser, P.; Eigenbrodt, E. (2002). Regulatory potential of *n*-3 fatty acids in immunological and inflammatory processes. *British Journal of Nutrition*, 87 (suppl.), 1, S59-S67.
26. Grundy, S.M. (1994). Influence of stearic acid on cholesterol metabolism relative to other long-chain fatty acids. *American Journal of Clinical Nutrition*, 60 (suppl.), 986S-990S.
27. Harbige, L.S.; Fisher, B.A. (2001). Dietary fatty acid modulation of mucosally-induced tolerogenic immune responses. *Proc. Nutr. Soc.*, 60(4), 449-456.
28. Hardman, W.E. (2002). Omega-3 fatty acids to augment cancer therapy. *Journal of Nutrition*, 132 (11 suppl.), 3508S-3512S.
29. Heller, A.R.; Fisher, S.; Rossel, T.; Geiger, S.; Siegert, G.; Ragaller, M.; Zimmermann, T.; Koch, T. (2002). Impact of *n*-3 fatty acid supplemented parenteral nutrition on haemostasis patterns after major abdominal surgery. *British Journal of Nutrition*, 87(Suppl.1), S95-S101.
30. Holness, D.H. (1991). *The tropical agriculturalist*. pigs. London and Oxford: Macmillan Education Ltd.
31. Honatra, G. (1974). Dietary fats and arterial thrombosis. *Haemostasis*, 2, 21-52.
32. Hornstra, G. (1992). Essential fatty acids, pregnancy and complications: a roundtable discussion. In: Sinclair, A.; Gibson, R. (eds.), *Essential fatty acids and eicosanoids*. Champaign: American Oil Chemists' Society, pp. 177-182.
33. Horrocks, L.A.; Yeo, Y.K. (1999). Health benefits of docosahexanoic acid (DHA). *Pharmacol. Res.*, 40(3), 211-225.
34. Hu, F.B.; Stampfer, J.; Manson, J.E.; Rimm, E.B.; Wolk, A.; Colditz, G.A.; Hennekens, C.H.; Willett, W.C. (1999). Dietary intake of alpha-linolenic acid and risk of fatal ischemic heart disease among women. *Am. J. Clin. Nutr.*, 69,890-897.
35. IUPAC (2001). Lexicon of lipid nutrition (IUPAC Technical Report). *Pure Appl. Chem.*, Vol. 73(4), 685-744.
36. Iso, H.; Sato, S.; Umemura, U.; Kudo, M.; Koike, K.; Kitamura, A.; Imano, H.; Okamura, T.; Naito, Y.; Shimamoto, T. (2002). Stroke. 33, 2086-2093.
37. Kepler, C.R.; Hirons, K.P.; McNeill, J.J.; Tove, S.B. (1966). Intermediates and products of the biohydrogenation of linoleic acid by *Butyrivibrio fibrisolvens*. *Journal of Biological Chemistry*, 241, 1350-1355.
38. Kim, H.Y. (2007). Novel metabloism of docosahexanoic acid in neural cells. *Journal of Biological Chemistry*, 282, 18661-18665.
39. Kim, H. Y.; Bigelow, J.; Kevala, J.H. (2004). Substrate preference in phosphatidylserine biosynthesis for docosahexanoic acid containing species. *Biochemistry*, 43, 1030-1036.
40. Kinsella, J.E. (1990). Possible mechanisms underlying the effects of *n*-3 polyunsaturated fatty acids. *Omega-3 News*, 5, 1-5.
41. Kramer, K.G.; Sehat,N.; Dugan, M.E.R.; Mossoba, M.M.; Yurawecz, M.P.; Roach, J.G.; Eulitz, K.; Aalhus, J.L.; Schaefer, A.L.; Ku, Y. (1998). Distribution of conjugated linoleic acid (CLA) isomers in tissue lipid classes of pigs fed a commercial CLA mixture by gas chromatography and silver ion-high-performance liquid chromatography. *Lipids*, 33, 549-558.
42. Kremer, J.M. (2000). N-3 fatty acid supplements in rheumatoid arthritis. *Americam Journal of Clinical Nutrition*, 71 (1 suppl.), 349S-351S.
43. Lord, R.S.; Bralley, J.A. (2001). Copyright 2001 Metamatrix Inc. Metamatrix is a service mark registered with the United States Patent and Trademark office (www.metamatrix.com)
44. Mantzioris, E.; Clenad, L.G.; Gibson, R.A.; Neuman, M. A.; Demasi, M.; James, M.J. (2000). Biochemical effects of a diet containing foods enriched with *n*-3 fatty acids. *American Journal of Clinical Nutrition*, 72, 42-48.

45. Mohrhauer, H.; Bahm, J.J.; Seufert, J.; Holman, R.T. (1967). Metabolism of linoleic acid in relation to dietary monoenoic fatty acids in the rat. *Journal of Nutrition*, 91(4), 521-527.
46. Mozzi, R.; Buratta, S.; Goracci, G. (2003). Metabolism and functions of phosphatidylserine in mammalian brain. *Neurochem Res.*, 28, 195-214.
47. Nestel, P.; Clifton, P.; Noakes, M. (1994). Effects of increasing dietary palmitoleic acid compared with palmitic and oleic acids on plasma lipids of hypercholesterolemic men. *Journal of Lipid Research*, 35, 656-662.
48. Neuringer, M.; Connor, W.E.; Lin, D.S.; Barstad, L.; Luck, S. (1986). Biochemical and functional effects of prenatal and postnatal omega-6 fatty acid deficiency on retina and brain in rhesus monkeys. *Proc. Natl. Acad. Sci. USA*, 83, 4021-4025.
49. Nishizuka, Y. (1986). Studies and perspectives of protein kinase C. *Science*, 233, 305-312.
50. Oloyo, R.A. (2001). *Fundamentals of research methodology for social and applied sciences*. Ilaro, Nigeria: ROA Educational Press.
51. Pal, S.; Thomson, A.M.; Bottema, C.D.; Roach, P.D. (2002). Polyunsaturated fatty acids downregulate the low density lipoprotein receptor of human HepG2 cells. *Journal of Nutritional Biochemistry*, 13 (1), 55-63.
52. Paul, A.A.; Southgate, D.A.T. (1978). *McCance and Widdowson's The Composition of Foods* (4th ed.). London: HMSO.
53. Phillips, K.M.; Wolf, W.R.; Patterson, K.Y.; Sharpless, K.E.; Amanna, K.R.; Holden, J.M. (2007). Summary of reference materials for the determination of the nutrient composition of Foods. *Accred. Qual. Assur.*, 12, 126-133.
54. Puri, B.; Counsell, S.J.; Hammliton, G.; Richardson, A.J.; Horrobin, D.F. (2001). Eicosapentaenoic acid in treatment-resistant depression associated with symptom remission, structural brain changes and reduced neuronal phospholipids turnover. *Int. J. Clin. Pract.*, 55(8), 560-563.
55. Raheja, R.K.; Kaur, C.; Singh, A.; Bhatia, I.S. (1973). New colorimetric method for the quantitative estimation of phospholipids without acid digestion. *Journal of Lipid Research*, 14, 695-697.
56. Rasmussen, M.; Moser, A.B.; Borel, J.; Khangoora, S.; Moser, H.W. (1994). Brain, liver and adipose tissue erucic and very long chain fatty acids levels in adrenoleukodystrophy patients treated with glyceryl tri-erucate and trioleate oils (Lorenzo's oil). *Neurochem. Res.*, 19, 1073-1082.
57. Renaud, S.; Lanzmann-Petithory, D. (2002). Dietary fats and coronary heart disease pathogenesis. *Curr. Atheroscler. Rep.*, 4, 419-424.
58. Reiser, R.; Shorland, F.B. (1990). Meat fats and fatty acids. In: Pearson, L.J.; Dutson, T.R. (editors). *Meat and health*. Advances in Meat Research, vol.6, Elsevier, Applied Science.
59. Royal Society (1972). *Metric units, conversion factors and nomenclature in nutritional and food sciences*. Report of the subcommittee on metrication of the British National Committee for Nutritional Sciences, London.
60. Sanderson, P.; Finnegan, Y.E.; Williams, C.M.; Calder, P.C.; Burdge, G.C.; Wootton, S.A.; Griffin, B.A.; Millward, D.J.; Pegge, N.C.; Bemelmans, W.J.E. (2002). UK food standards agency α -linolenic acid workshop report. *British Journal of Nutrition*, 88, 573-579.
61. Sargent, J.R.; Coupland, K.; Wilson, R. (1994). Nervonic acid and demyelinating diseases. *Med. Hypotheses*, 42, 237-242.
62. Simopoulos, A.P. (2002). The importance of the ratio of omega-6/omega-3 essential fatty acids. *Biomed. Pharmacother.*, 56(8), 365-379.
63. Souci, S.V.; Fachmann, W.; Kraut, H. (1990). Food composition and nutrition tables 1989/1990. Wissenschaftliche Verlagsgesellschaft mbH Stuttgart.
64. Tapiero, H.; Nguyen, Ba G.; Couvreur, P.; Tew, K.D. (2002). Polyunsaturated fatty acids (PUFA) and eicosanoids in human health and pathologies. *Biomedicine and Pharmacotherapy*, 56, 215-222.
65. Vance, J.E. (2008). Phosphatidylserine and phosphatidylethanolamine in mammalian cells: two metabolically-related aminophospholipids. *Journal of Lipid Research*, 49(7), 1377-1387.
66. Weber, N.; Richter, Klaus-Dieter, Schilte, E.; Mukherjee, K.D. (1995). Petroselinic acid from dietary triacylglycerols reduces the concentration of arachidonic acid in tissue lipids of rats. *Journal of Nutrition*, 125, 1563-1568.
67. West, D.B.; Delany, J.P.; Camet, P.M.; Blohm, F.; Truett, A.A.; Scimeca, J. (1998). Effect of conjugated linoleic acid on body fat and energy metabolism in the mouse. *Am. J. Physiol.*, 275, R667-R672.
68. Whetsell, M.S.; Rayburn, E.B.; Lozier, J.D. (2003). Human health effects of fatty acids in beef. *Pasture-Based Beef Systems for Appalachia*, Extension Service, West Virginia University.
69. Whitney, E.N.; Cataldo, C.B.; Rolfes, S.R. (1994). *Understanding normal and clinical nutrition* (4th ed.). New York: West Publishing Company.
70. WHO/FAO (1994). *Fats and oil in human nutrition*. Report of a joint consultation FAO Food and Nutrition Paper 57. Rome: WHO/FAO.

Table 1 : Crude fat, true total fatty acid and total energy levels of the different domestic pig organs

Parameters	Liver	Muscle	Brain	Mean	SD	CV%
Crude fat (g/100g)	2.85	3.59	4.36	3.60	0.76	21.0
True total fatty acids (g/100g) ^a	2.11	3.42	2.45	2.66	0.68	25.6
Total energy (kJ/100g)	105	133	161	133	28	21.1

^aLiver (2.85x0.741); muscle (3.59 x 0.953); brain (4.36 x 0.561). SD = standard deviation.

CV% =coefficient of variation percent.

Table 2 : Saturated and monounsaturated fatty acid composition of the three different organs of domestic pig (% total fatty acid weight)

Fatty acid	Liver	Muscle	Brain	Mean	SD	CV%
Hexanoic acid (C6:0)	0.00	0.00	0.00	0.00	-	-
Octanoic acid (C8:0)	0.00	0.384	0.00	0.128	0.222	173
Decanoic acid (C10:0)	0.00	0.058	0.00	0.019	0.034	173
Lauric acid (C12:0)	0.264	0.425	0.294	0.328	0.086	26.1
Myristic acid (C14:0)	2.23	4.97	2.55	3.25	1.50	46.1
Palmitic acid (C16:0)	24.9	23.9	21.2	23.3	1.90	8.15
Stearic acid (C18:0)	7.70	8.21	10.4	8.76	1.41	16.1
Arachidic acid (C20:0)	0.046	1.93	0.026	0.669	1.10	164
Behenic acid (C22:0)	0.043	0.019	0.024	0.028	0.013	44.1
Lignoceric acid (C24:0)	0.005	0.002	0.003	0.004	0.002	44.1
Total SFA	35.1	39.9	34.4	36.5	2.97	8.13
Myristoleic acid (C14: 1 <i>cis</i> - 9)	0.006	0.003	0.003	0.004	0.002	44.1
Palmitoleic acid (C16: 1 <i>cis</i> - 9)	6.81	6.95	6.39	6.72	0.294	4.37
Petroselinic acid (C18: 1 <i>cis</i> -6)	12.5	8.64	13.7	11.6	2.66	22.9
Oleic acid (C18: 1 <i>cis</i> - 9)	12.0	15.1	10.0	12.4	2.57	20.8
Gondoic acid (C20: 1 <i>cis</i> - 11)	4.87	4.19	4.15	4.40	0.408	9.26
Erucic acid (C22:1 <i>cis</i> -13)	1.46	1.32	1.19	1.32	0.135	10.2
Nervonic acid (C24:1 <i>cis</i> -15)	0.005	0.002	0.003	0.004	0.002	44.1
MUFA (<i>cis</i>)	37.7	36.2	35.5	36.5	1.11	3.05
<i>Trans</i> - Petroselinic acid (C18: 1 <i>trans</i> -6)	0.017	0.007	0.009	0.011	0.005	44.1
Elaidic acid (C18:1 <i>trans</i> -9)	0.00	0.001	0.001	0.0001	0.0004	44.1
Vaccenic acid (C18:1 <i>trans</i> -11)	0.00	0.00	0.00	-	-	-
MUFA (<i>trans</i>)	0.018	0.008	0.010	0.012	0.005	44.1
MUFA (total)	37.7	36.2	35.5	36.5	1.12	3.06

SFA = saturated fatty acid; MUFA = monounsaturated fatty acid.

Table 3 : PUFA *n*-6 and *n*-3 fatty acid composition of the three organs of domestic pig (% total fatty acids)

Fatty acid	Liver	Muscle	Brain	Mean	SD	CV%
Linoleic acid (LA) (C18: 2 <i>cis</i> -9,12)	1.05	1.87	0.760	1.23	0.578	47.1
Gamma- linolenic acid (C18:3 <i>cis</i> -6,9,12)	0.055	0.991	0.031	0.359	0.548	152
Eicosadienoic acid (C20: 2 <i>cis</i> -11,14)	0.007	2.07	0.004	0.692	1.19	172
Dihomo- γ -linolenic acid (C20:3 <i>cis</i> -8,11,14)	0.233	0.355	0.336	0.308	0.066	21.3
Arachidonic acid (AA) (C20:4 <i>cis</i> -5,8,11,14)	4.58	2.21	6.79	4.53	2.29	50.7
Docosadienoic acid (C22:2 <i>cis</i> -13,16)	0.088	0.175	0.349	0.204	0.133	65.3
<i>n</i>-6 PUFA (<i>cis</i>)	6.01	7.67	8.27	7.32	1.17	16.0
Rumenic acid (C18:2 <i>cis</i> -9, <i>trans</i> -11)	0.019	0.090	0.011	0.040	0.043	108
<i>n</i>-6 PUFA (total)	6.03	7.76	8.28	7.36	1.18	16.0
Alpha-linolenic acid (ALA)(C18:3 <i>cis</i> -9,12,15)	0.043	0.629	0.024	0.232	0.344	148
Eicosatrienoic acid (ETA)(C20:3 <i>cis</i> -11,14,17)	0.028	0.012	0.016	0.019	0.008	44.1
Timnodonic acid (EPA) (C20:5 <i>cis</i> -5,8,11,14,17)	1.55	4.96	1.72	2.74	1.92	70.1
Cervonic acid (DHA)(C22:6 <i>cis</i> -4,7,10,13,16,19)	19.5	10.5	20.0	16.7	5.35	32.1
Total <i>n</i>-3	21.1	16.1	21.8	19.7	3.11	15.8
<i>n</i>-6 + <i>n</i>-3 (total)	27.2	23.9	30.1	27.1	3.10	11.5

PUFA = polyunsaturated fatty acid.

Table 4 : Summary of quality characteristics of the fatty acids profile

Fatty acid	Liver	Muscle	Brain	Mean	SD	CV%
Total PUFA <i>n</i> -6	6.03	7.76	8.28	7.36	1.18	16.0
Total PUFA <i>n</i> -3	21.1	16.1	21.8	19.7	3.11	15.8
Total PUFA (<i>n</i> -3 + <i>n</i> -6)	27.2	23.9	30.1	27.1	3.10	11.5
MUFA total (<i>cis</i>)	37.7	36.2	35.5	36.5	1.11	3.05
MUFA total (<i>trans</i>)	0.018	0.008	0.010	0.012	0.005	44.1
MUFA total	37.7	36.2	35.5	36.5	1.12	3.06
SFA total	35.1	39.9	34.4	36.5	2.97	8.13
MUFA + PUFA	64.9	60.1	65.6	63.5	2.99	4.71
<i>n</i> -6/ <i>n</i> -3	0.285	0.481	0.380	0.382	0.098	25.7
PUFA/SFA	0.773	0.598	0.873	0.748	0.139	18.6
MUFA/SFA	1.07	0.908	1.03	1.00	0.084	8.42
EPSI	0.721	0.659	0.848	0.743	0.096	13.0
AA/DGLA	19.6	6.22	20.2	15.3	7.90	51.5
LA/ALA	24.5	2.98	31.7	19.7	14.9	75.8
EPA/DHA	0.079	0.472	0.086	0.212	0.225	106
Ratio	1:1	1:1	1:1	-	-	-

EPSI = essential PUFA status index.

Table 5 : Fatty acid levels in the domestic pig per 100g liver, muscle and brain samples as food

Fatty acid	Liver	Muscle	Brain	Mean	SD	CV%
C6:0	-	-	-	-	-	-
C8:0	-	0.013	-	-	-	-
C10:0	-	0.002	-	-	-	-
C12:0	0.006	0.015	0.007	0.009	0.005	52.9
C14:0	0.047	0.170	0.062	0.093	0.067	72.2
C16:0	0.525	0.818	0.518	0.620	0.171	27.5
C18:0	0.163	0.281	0.253	0.232	0.062	26.5
C20:0	0.001	0.066	0.001	0.023	0.038	166
C22:0	0.001	0.001	0.001	0.001	0.00	-
C24:0	0.00	0.00	0.00	-	-	-
SFA	0.743	1.366	0.842	0.985	0.337	34.2
C14: 1(<i>cis</i> -9)	0.00	0.00	0.00	-	-	-
C16: (1 <i>cis</i> -9)	0.144	0.238	0.156	0.179	0.051	28.5
C18: (1 <i>cis</i> -6)	0.264	0.296	0.336	0.298	0.036	12.1
C18: (1 <i>cis</i> -9)	0.254	0.517	0.245	0.339	0.155	45.6
C20: (1 <i>cis</i> -11)	0.103	0.143	0.102	0.116	0.023	20.2
C22:0(1 <i>cis</i> -13)	0.031	0.045	0.029	0.035	0.009	24.9
C24:1(<i>cis</i> -15)	0.00	0.00	0.00	-	-	-
MUFA (<i>cis</i>)	0.796	1.239	0.868	0.968	0.238	24.6
C18: 1 (<i>trans</i> -6)	0.00	0.00	0.00	-	-	-
C18:1(<i>trans</i> -9)	0.00	0.00	0.00	-	-	-
C18:1 (<i>trans</i> -11)	0.00	0.00	0.00	-	-	-
MUFA (<i>trans</i>)	0.00	0.00	0.00	-	-	-
MUFA (total)	0.796	1.239	0.868	0.968	0.238	24.6
C18: 2 (<i>cis</i> -9,12)	0.022	0.064	0.019	0.035	0.025	71.9
C18:2 (<i>cis</i> -9, <i>trans</i> -11)	0.00	0.003	0.00	-	-	-
C18:3 (<i>cis</i> -6,9,12)	0.001	0.034	0.001	0.012	0.019	159
C20: 2 (<i>cis</i> -11,14)	0.00	0.071	0.00	-	-	-
C20:3 (<i>cis</i> -8,11,14)	0.005	0.012	0.008	0.008	0.004	42.1
C20:4 (<i>cis</i> -5,8,11,14)	0.097	0.076	0.166	0.113	0.047	41.7
C22:2 (<i>cis</i> -13,16)	0.002	0.006	0.009	0.006	0.004	62.0
C18:3 (<i>cis</i> -9,12,15)	0.001	0.023	0.001	0.008	0.012	152
C20:3 (<i>cis</i> -11,14,17)	0.001	0.00	0.00	-	-	-
C20:5 (<i>cis</i> -5,8,11,14,17)	0.033	0.170	0.042	0.082	0.077	93.8
C22:6 (<i>cis</i> -4,7,10,13,16,19)	0.412	0.359	0.490	0.421	0.065	15.6
PUFA (<i>n</i> -6, total)	0.127	0.266	0.203	0.199	0.070	35.0
PUFA (<i>n</i> -3, total)	0.447	0.551	0.533	0.511	0.056	11.0
PUFA (<i>n</i> -6+ <i>n</i> -3 total)	0.574	0.817	0.736	0.709	0.124	17.5
MUFA+ PUFA (total)	1.37	2.06	1.60	1.68	0.351	21.0
Total (SFA + MUFA+ PUFA)	2.11	3.42	2.45	2.66	0.685	25.7

Table 6: Energy contribution (kJ/100g) of the domestic pig organs

Parameter	Liver	Muscle	Brain	Mean	SD	CV%
SFA	27.5 (35.2%)	50.5 (39.8%)	31.2 (34.5%)	36.4 (36.9%)	12.4	33.9
MUFA (<i>cis</i>)	29.5 (37.7%)	45.8 (36.1%)	32.1 (35.5%)	35.8 (36.3%)	8.76	24.5
MUFA (<i>trans</i>)	0.00	0.00	0.00	0.00	-	-
MUFA (total)	29.5 (37.7%)	45.8 (36.1%)	32.1 (35.5%)	35.8 (36.3%)	8.76	24.5
<i>n</i> -6 PUFA	4.70 (6.01%)	9.84 (7.75%)	7.51 (8.30%)	7.35 (7.45%)	2.57	35.0
<i>n</i> -3 PUFA	16.5 (21.1%)	20.4 (16.1%)	19.7 (21.8%)	18.9 (19.2%)	2.08	11.0
PUFA (total)	21.2 (27.1%)	30.2 (23.8%)	27.2 (30.1%)	26.2 (26.6%)	4.58	17.5
MUFA + PUFA	50.7 (64.8%)	76.2 (60.0%)	59.2 (65.4%)	62.0 (62.9%)	13.0	20.9
SFA + MUFA + PUFA (TFAE)	78.2 (100%)	127 (100%)	90.5 (100%)	98.6 (100%)	25.4	25.7

TFAE = total fatty acid energy in kJ/100g fat as food.

Table 7: Statistical analysis of the results from Table 4

Statistics	Liver/Muscle	Muscle/Brain	Liver/Brain
Correlation coefficient (r_{xy})	0.874	0.806	0.9874
Coefficient of determination (r_{xy}^2)	0.7638	0.650	0.9745
Regression coefficient (R_c)	-1.34	5.99	0.7475
Mean of X	14.6	11.3	14.5
$X \pm SD$	14.5	14.5	14.6
Mean of Y	11.3	15.4	15.4
$Y \pm SD$	14.5	14.9	14.9
Coefficient of alienation (C_A)	0.486	0.350	0.1585
Index of forecasting efficiency (IFE)	0.514	0.650	0.8415
Remark	Significant	Significant	Significant

X is liver, muscle, liver

Y is muscle, brain, brain

as they pair in liver/muscle; muscle/brain; liver/brain.

SD = standard deviation.

Results significantly different at df 10 and $r_{0.05}$ (with value of 0.576).

Table 8: Phospholipids level (mg/100g) of the three organs of the domestic pig

Phospholipid	Liver	Muscle	Brain	Mean	SD	CV%
Cephalin (PE)	95.7 (27.2)	95.9 (24.7)	133 (25.1)	108 (25.5)	21.5	19.9
Lecithin	223 (63.4)	248 (63.8)	307 (58.0)	259 (61.2)	43.5	16.8
Ptd-L-Ser (PS)	12.9 (3.66)	15.0 (3.86)	33.6 (6.35)	20.5 (4.85)	11.4	55.5
Lysophosphatidylcholine	3.68 (1.05)	6.59 (1.69)	18.0 (3.40)	9.41 (2.22)	7.54	80.2
Ptd Ins (PI)	17.4 (4.94)	22.9 (5.89)	37.1 (7.01)	25.8 (6.10)	10.2	39.5
Total	352 (100)	389 (100)	529 (100)	423 (100)	93.4	22.1

PE = phosphatidylethanolamine;

Lecithin = phosphatidylcholine;

PS = phosphatidylserine;

PI = phosphatidylinositol;

Values in parentheses are in percentages.

Table 9 : Statistical analysis of the results from Table 8

Statistics	Liver/Muscle	Muscle/Brain	Liver/Brain
r_{xy}	0.9985	0.9995	0.9996
r_{xy}^2	0.9971	0.9989	0.9992
R_c	0.4936	13.1	13.5
Mean of X	70.5	77.7	70.5
$X \pm SD$	92.7	102	92.7
Mean of Y	77.7	106	106
$Y \pm SD$	102	122	122
C_A	0.0541	0.0324	0.0289
IFE	0.9459	0.9676	0.9711
Remark	Significant	Significant	Significant

Results significantly different at df 3 and $r =_{0.05}$ (with value of 0.878).

Table 10 : Sterol levels (mg/100g) of the three different organs of the domestic pig

Sterol	Liver	Muscle	Brain	Mean	SD	CV%
Cholesterol*	50.73271 (99.996)	57.90563 (99.996)	89.27982 (99.997)	66.0	20.5	31.1
Cholestanol	4.92e-4	5.95e-4	5.76e-4	-	-	9.79
Ergosterol	5.66e-4	6.98e-4	6.81e-4	-	-	11.0
Campesterol	2.87e-4	2.81e-4	9.82e-4	-	-	77.9
Stig-masterol	5.24e-5	7.04e-5	6.54e-5	-	-	14.8
5-Avenasterol	4.60e-4	4.64e-4	4.62e-4	-	-	0.331
Sitosterol	7.41e-6	1.08e-5	8.73e-6	-	-	19.2
Total	50.73458	57.90775	89.2826	66.0	20.5	31.1

Values in parentheses are percentage values.

*Cholesterol subjected to chi-square (X^2) analysis showed no significant difference.

Table 11 : Uncertainty interval as percentage of analytical results

Parameter	UIP (table) ⁺	UIP (Liver)	UIP (Muscle)	UIP (Brain)
Fatty acid:				
C16:0	1.2	1.2	1.26	1.42
C18:0	0.9	2.1	1.95	1.55
C16:1	6.2	2.35	2.30	2.50
C18:1	0.9	-	-	-
C18:1 (<i>cis</i> - 6)	-	2.88	4.17	2.62
C18:1 (<i>cis</i> - 9)	-	3.00	2.38	3.60
C18:2	2.4	-	-	-
C18:2 (<i>cis</i> - 9, 12)	-	16.2	9.08	22.4
C18:3	16.3	-	-	-
C18:3 (<i>cis</i> - 9, 12, 15)	-	327	22.2	584
Sterol:				
Cholesterol	3.5	9.26	8.20	5.26

UIP = uncertainty interval percent

⁺UIP(table) = UIP adapted from Beef – Pork Fat Blend.

GLOBAL JOURNALS INC. (US) GUIDELINES HANDBOOK 2013

WWW.GLOBALJOURNALS.ORG

FELLOWS

FELLOW OF ASSOCIATION OF RESEARCH SOCIETY IN SCIENCE (FARSS)

- 'FARSS' title will be awarded to the person after approval of Editor-in-Chief and Editorial Board. The title 'FARSS' can be added to name in the following manner. eg. Dr. John E. Hall, Ph.D., FARSS or William Walldroff Ph. D., M.S., FARSS
- Being FARSS is a respectful honor. It authenticates your research activities. After becoming FARSS, you can use 'FARSS' title as you use your degree in suffix of your name. This will definitely will enhance and add up your name. You can use it on your Career Counseling Materials/CV/Resume/Visiting Card/Name Plate etc.
- 60% Discount will be provided to FARSS members for publishing research papers in Global Journals Inc., if our Editorial Board and Peer Reviewers accept the paper. For the life time, if you are author/co-author of any paper bill sent to you will automatically be discounted one by 60%
- FARSS will be given a renowned, secure, free professional email address with 100 GB of space eg.johnhall@globaljournals.org. You will be facilitated with Webmail, SpamAssassin, Email Forwarders, Auto-Responders, Email Delivery Route tracing, etc.
- FARSS member is eligible to become paid peer reviewer at Global Journals Inc. to earn up to 15% of realized author charges taken from author of respective paper. After reviewing 5 or more papers you can request to transfer the amount to your bank account or to your PayPal account.
- Eg. If we had taken 420 USD from author, we can send 63 USD to your account.
- FARSS member can apply for free approval, grading and certification of some of their Educational and Institutional Degrees from Global Journals Inc. (US) and Open Association of Research,Society U.S.A.
- After you are FARSS. You can send us scanned copy of all of your documents. We will verify, grade and certify them within a month. It will be based on your academic records, quality of research papers published by you, and 50 more criteria. This is beneficial for your job interviews as recruiting organization need not just rely on you for authenticity and your unknown qualities, you would have authentic ranks of all of your documents. Our scale is unique worldwide.
- FARSS member can proceed to get benefits of free research podcasting in Global Research Radio with their research documents, slides and online movies.
- After your publication anywhere in the world, you can upload you research paper with your recorded voice or you can use our professional RJs to record your paper their voice. We can also stream your conference videos and display your slides online.
- FARSS will be eligible for free application of Standardization of their Researches by Open Scientific Standards. Standardization is next step and level after publishing in a journal. A team of research and professional will work with you to take your research to its next level, which is worldwide open standardization.



- FARSS is eligible to earn from their researches: While publishing his paper with Global Journals Inc. (US), FARSS can decide whether he/she would like to publish his/her research in closed manner. When readers will buy that individual research paper for reading, 80% of its earning by Global Journals Inc. (US) will be transferred to FARSS member's bank account after certain threshold balance. There is no time limit for collection. FARSS member can decide its price and we can help in decision.

MEMBER OF ASSOCIATION OF RESEARCH SOCIETY IN SCIENCE (MARSS)

- 'MARSS' title will be awarded to the person after approval of Editor-in-Chief and Editorial Board. The title 'MARSS' can be added to name in the following manner. eg. Dr. John E. Hall, Ph.D., MARSS or William Walldroff Ph. D., M.S., MARSS
- Being MARSS is a respectful honor. It authenticates your research activities. After becoming MARSS, you can use 'MARSS' title as you use your degree in suffix of your name. This will definitely will enhance and add up your name. You can use it on your Career Counseling Materials/CV/Resume/Visiting Card/Name Plate etc.
- 40% Discount will be provided to MARSS members for publishing research papers in Global Journals Inc., if our Editorial Board and Peer Reviewers accept the paper. For the life time, if you are author/co-author of any paper bill sent to you will automatically be discounted one by 60%
- MARSS will be given a renowned, secure, free professional email address with 30 GB of space eg.johnhall@globaljournals.org. You will be facilitated with Webmail, SpamAssassin, Email Forwarders, Auto-Responders, Email Delivery Route tracing, etc.
- MARSS member is eligible to become paid peer reviewer at Global Journals Inc. to earn up to 10% of realized author charges taken from author of respective paper. After reviewing 5 or more papers you can request to transfer the amount to your bank account or to your PayPal account.
- MARSS member can apply for free approval, grading and certification of some of their Educational and Institutional Degrees from Global Journals Inc. (US) and Open Association of Research,Society U.S.A.
- MARSS is eligible to earn from their researches: While publishing his paper with Global Journals Inc. (US), MARSS can decide whether he/she would like to publish his/her research in closed manner. When readers will buy that individual research paper for reading, 40% of its earning by Global Journals Inc. (US) will be transferred to MARSS member's bank account after certain threshold balance. There is no time limit for collection. MARSS member can decide its price and we can help in decision.



AUXILIARY MEMBERSHIPS

ANNUAL MEMBER

- Annual Member will be authorized to receive e-Journal GJSFR for one year (subscription for one year).
- The member will be allotted free 1 GB Web-space along with subDomain to contribute and participate in our activities.
- A professional email address will be allotted free 500 MB email space.

PAPER PUBLICATION

- The members can publish paper once. The paper will be sent to two-peer reviewer. The paper will be published after the acceptance of peer reviewers and Editorial Board.

PROCESS OF SUBMISSION OF RESEARCH PAPER

The Area or field of specialization may or may not be of any category as mentioned in 'Scope of Journal' menu of the GlobalJournals.org website. There are 37 Research Journal categorized with Six parental Journals GJCST, GJMR, GJRE, GJMBR, GJSFR, GJHSS. For Authors should prefer the mentioned categories. There are three widely used systems UDC, DDC and LCC. The details are available as 'Knowledge Abstract' at Home page. The major advantage of this coding is that, the research work will be exposed to and shared with all over the world as we are being abstracted and indexed worldwide.

The paper should be in proper format. The format can be downloaded from first page of 'Author Guideline' Menu. The Author is expected to follow the general rules as mentioned in this menu. The paper should be written in MS-Word Format (*.DOC,*.DOCX).

The Author can submit the paper either online or offline. The authors should prefer online submission.Online Submission: There are three ways to submit your paper:

(A) (I) First, register yourself using top right corner of Home page then Login. If you are already registered, then login using your username and password.

(II) Choose corresponding Journal.

(III) Click 'Submit Manuscript'. Fill required information and Upload the paper.

(B) If you are using Internet Explorer, then Direct Submission through Homepage is also available.

(C) If these two are not convenient, and then email the paper directly to dean@globaljournals.org.

Offline Submission: Author can send the typed form of paper by Post. However, online submission should be preferred.



PREFERRED AUTHOR GUIDELINES

MANUSCRIPT STYLE INSTRUCTION (Must be strictly followed)

Page Size: 8.27" X 11"

- Left Margin: 0.65
- Right Margin: 0.65
- Top Margin: 0.75
- Bottom Margin: 0.75
- Font type of all text should be Swis 721 Lt BT.
- Paper Title should be of Font Size 24 with one Column section.
- Author Name in Font Size of 11 with one column as of Title.
- Abstract Font size of 9 Bold, "Abstract" word in Italic Bold.
- Main Text: Font size 10 with justified two columns section
- Two Column with Equal Column with of 3.38 and Gaping of .2
- First Character must be three lines Drop capped.
- Paragraph before Spacing of 1 pt and After of 0 pt.
- Line Spacing of 1 pt
- Large Images must be in One Column
- Numbering of First Main Headings (Heading 1) must be in Roman Letters, Capital Letter, and Font Size of 10.
- Numbering of Second Main Headings (Heading 2) must be in Alphabets, Italic, and Font Size of 10.

You can use your own standard format also.

Author Guidelines:

1. General,
2. Ethical Guidelines,
3. Submission of Manuscripts,
4. Manuscript's Category,
5. Structure and Format of Manuscript,
6. After Acceptance.

1. GENERAL

Before submitting your research paper, one is advised to go through the details as mentioned in following heads. It will be beneficial, while peer reviewer justify your paper for publication.

Scope

The Global Journals Inc. (US) welcome the submission of original paper, review paper, survey article relevant to the all the streams of Philosophy and knowledge. The Global Journals Inc. (US) is parental platform for Global Journal of Computer Science and Technology, Researches in Engineering, Medical Research, Science Frontier Research, Human Social Science, Management, and Business organization. The choice of specific field can be done otherwise as following in Abstracting and Indexing Page on this Website. As the all Global

Journals Inc. (US) are being abstracted and indexed (in process) by most of the reputed organizations. Topics of only narrow interest will not be accepted unless they have wider potential or consequences.

2. ETHICAL GUIDELINES

Authors should follow the ethical guidelines as mentioned below for publication of research paper and research activities.

Papers are accepted on strict understanding that the material in whole or in part has not been, nor is being, considered for publication elsewhere. If the paper once accepted by Global Journals Inc. (US) and Editorial Board, will become the copyright of the Global Journals Inc. (US).

Authorship: The authors and coauthors should have active contribution to conception design, analysis and interpretation of findings. They should critically review the contents and drafting of the paper. All should approve the final version of the paper before submission

The Global Journals Inc. (US) follows the definition of authorship set up by the Global Academy of Research and Development. According to the Global Academy of R&D authorship, criteria must be based on:

- 1) Substantial contributions to conception and acquisition of data, analysis and interpretation of the findings.
- 2) Drafting the paper and revising it critically regarding important academic content.
- 3) Final approval of the version of the paper to be published.

All authors should have been credited according to their appropriate contribution in research activity and preparing paper. Contributors who do not match the criteria as authors may be mentioned under Acknowledgement.

Acknowledgements: Contributors to the research other than authors credited should be mentioned under acknowledgement. The specifications of the source of funding for the research if appropriate can be included. Suppliers of resources may be mentioned along with address.

Appeal of Decision: The Editorial Board's decision on publication of the paper is final and cannot be appealed elsewhere.

Permissions: It is the author's responsibility to have prior permission if all or parts of earlier published illustrations are used in this paper.

Please mention proper reference and appropriate acknowledgements wherever expected.

If all or parts of previously published illustrations are used, permission must be taken from the copyright holder concerned. It is the author's responsibility to take these in writing.

Approval for reproduction/modification of any information (including figures and tables) published elsewhere must be obtained by the authors/copyright holders before submission of the manuscript. Contributors (Authors) are responsible for any copyright fee involved.

3. SUBMISSION OF MANUSCRIPTS

Manuscripts should be uploaded via this online submission page. The online submission is most efficient method for submission of papers, as it enables rapid distribution of manuscripts and consequently speeds up the review procedure. It also enables authors to know the status of their own manuscripts by emailing us. Complete instructions for submitting a paper is available below.

Manuscript submission is a systematic procedure and little preparation is required beyond having all parts of your manuscript in a given format and a computer with an Internet connection and a Web browser. Full help and instructions are provided on-screen. As an author, you will be prompted for login and manuscript details as Field of Paper and then to upload your manuscript file(s) according to the instructions.



To avoid postal delays, all transaction is preferred by e-mail. A finished manuscript submission is confirmed by e-mail immediately and your paper enters the editorial process with no postal delays. When a conclusion is made about the publication of your paper by our Editorial Board, revisions can be submitted online with the same procedure, with an occasion to view and respond to all comments.

Complete support for both authors and co-author is provided.

4. MANUSCRIPT'S CATEGORY

Based on potential and nature, the manuscript can be categorized under the following heads:

Original research paper: Such papers are reports of high-level significant original research work.

Review papers: These are concise, significant but helpful and decisive topics for young researchers.

Research articles: These are handled with small investigation and applications

Research letters: The letters are small and concise comments on previously published matters.

5. STRUCTURE AND FORMAT OF MANUSCRIPT

The recommended size of original research paper is less than seven thousand words, review papers fewer than seven thousands words also. Preparation of research paper or how to write research paper, are major hurdle, while writing manuscript. The research articles and research letters should be fewer than three thousand words, the structure original research paper; sometime review paper should be as follows:

Papers: These are reports of significant research (typically less than 7000 words equivalent, including tables, figures, references), and comprise:

- (a) Title should be relevant and commensurate with the theme of the paper.
- (b) A brief Summary, "Abstract" (less than 150 words) containing the major results and conclusions.
- (c) Up to ten keywords, that precisely identifies the paper's subject, purpose, and focus.
- (d) An Introduction, giving necessary background excluding subheadings; objectives must be clearly declared.
- (e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition; sources of information must be given and numerical methods must be specified by reference, unless non-standard.
- (f) Results should be presented concisely, by well-designed tables and/or figures; the same data may not be used in both; suitable statistical data should be given. All data must be obtained with attention to numerical detail in the planning stage. As reproduced design has been recognized to be important to experiments for a considerable time, the Editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned un-refereed;
- (g) Discussion should cover the implications and consequences, not just recapitulating the results; conclusions should be summarizing.
- (h) Brief Acknowledgements.
- (i) References in the proper form.

Authors should very cautiously consider the preparation of papers to ensure that they communicate efficiently. Papers are much more likely to be accepted, if they are cautiously designed and laid out, contain few or no errors, are summarizing, and be conventional to the approach and instructions. They will in addition, be published with much less delays than those that require much technical and editorial correction.



The Editorial Board reserves the right to make literary corrections and to make suggestions to improve briefness.

It is vital, that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

Format

Language: The language of publication is UK English. Authors, for whom English is a second language, must have their manuscript efficiently edited by an English-speaking person before submission to make sure that, the English is of high excellence. It is preferable, that manuscripts should be professionally edited.

Standard Usage, Abbreviations, and Units: Spelling and hyphenation should be conventional to The Concise Oxford English Dictionary. Statistics and measurements should at all times be given in figures, e.g. 16 min, except for when the number begins a sentence. When the number does not refer to a unit of measurement it should be spelt in full unless, it is 160 or greater.

Abbreviations supposed to be used carefully. The abbreviated name or expression is supposed to be cited in full at first usage, followed by the conventional abbreviation in parentheses.

Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than $1.4 \times 10^{-3} \text{ m}^3$, or 4 mm somewhat than $4 \times 10^{-3} \text{ m}$. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

Structure

All manuscripts submitted to Global Journals Inc. (US), ought to include:

Title: The title page must carry an instructive title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) wherever the work was carried out. The full postal address in addition with the e-mail address of related author must be given. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining and indexing.

Abstract, used in Original Papers and Reviews:

Optimizing Abstract for Search Engines

Many researchers searching for information online will use search engines such as Google, Yahoo or similar. By optimizing your paper for search engines, you will amplify the chance of someone finding it. This in turn will make it more likely to be viewed and/or cited in a further work. Global Journals Inc. (US) have compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Key Words

A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy and planning a list of possible keywords and phrases to try.

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art. A few tips for deciding as strategically as possible about keyword search:



- One should start brainstorming lists of possible keywords before even begin searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

The Editorial Board and Global Journals Inc. (US) recommend that, citation of online-published papers and other material should be done via a DOI (digital object identifier). If an author cites anything, which does not have a DOI, they run the risk of the cited material not being noticeable.

The Editorial Board and Global Journals Inc. (US) recommend the use of a tool such as Reference Manager for reference management and formatting.

Tables, Figures and Figure Legends

Tables: Tables should be few in number, cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g. Table 4, a self-explanatory caption and be on a separate sheet. Vertical lines should not be used.

Figures: Figures are supposed to be submitted as separate files. Always take in a citation in the text for each figure using Arabic numbers, e.g. Fig. 4. Artwork must be submitted online in electronic form by e-mailing them.

Preparation of Electronic Figures for Publication

Even though low quality images are sufficient for review purposes, print publication requires high quality images to prevent the final product being blurred or fuzzy. Submit (or e-mail) EPS (line art) or TIFF (halftone/photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Do not use pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings) in relation to the imitation size. Please give the data for figures in black and white or submit a Color Work Agreement Form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution (at final image size) ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs) : >350 dpi; figures containing both halftone and line images: >650 dpi.



Color Charges: It is the rule of the Global Journals Inc. (US) for authors to pay the full cost for the reproduction of their color artwork. Hence, please note that, if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a color work agreement form before your paper can be published.

Figure Legends: Self-explanatory legends of all figures should be incorporated separately under the heading 'Legends to Figures'. In the full-text online edition of the journal, figure legends may possibly be truncated in abbreviated links to the full screen version. Therefore, the first 100 characters of any legend should notify the reader, about the key aspects of the figure.

6. AFTER ACCEPTANCE

Upon approval of a paper for publication, the manuscript will be forwarded to the dean, who is responsible for the publication of the Global Journals Inc. (US).

6.1 Proof Corrections

The corresponding author will receive an e-mail alert containing a link to a website or will be attached. A working e-mail address must therefore be provided for the related author.

Acrobat Reader will be required in order to read this file. This software can be downloaded

(Free of charge) from the following website:

www.adobe.com/products/acrobat/readstep2.html. This will facilitate the file to be opened, read on screen, and printed out in order for any corrections to be added. Further instructions will be sent with the proof.

Proofs must be returned to the dean at dean@globaljournals.org within three days of receipt.

As changes to proofs are costly, we inquire that you only correct typesetting errors. All illustrations are retained by the publisher. Please note that the authors are responsible for all statements made in their work, including changes made by the copy editor.

6.2 Early View of Global Journals Inc. (US) (Publication Prior to Print)

The Global Journals Inc. (US) are enclosed by our publishing's Early View service. Early View articles are complete full-text articles sent in advance of their publication. Early View articles are absolute and final. They have been completely reviewed, revised and edited for publication, and the authors' final corrections have been incorporated. Because they are in final form, no changes can be made after sending them. The nature of Early View articles means that they do not yet have volume, issue or page numbers, so Early View articles cannot be cited in the conventional way.

6.3 Author Services

Online production tracking is available for your article through Author Services. Author Services enables authors to track their article - once it has been accepted - through the production process to publication online and in print. Authors can check the status of their articles online and choose to receive automated e-mails at key stages of production. The authors will receive an e-mail with a unique link that enables them to register and have their article automatically added to the system. Please ensure that a complete e-mail address is provided when submitting the manuscript.

6.4 Author Material Archive Policy

Please note that if not specifically requested, publisher will dispose off hardcopy & electronic information submitted, after the two months of publication. If you require the return of any information submitted, please inform the Editorial Board or dean as soon as possible.

6.5 Offprint and Extra Copies

A PDF offprint of the online-published article will be provided free of charge to the related author, and may be distributed according to the Publisher's terms and conditions. Additional paper offprint may be ordered by emailing us at: editor@globaljournals.org.



Before start writing a good quality Computer Science Research Paper, let us first understand what is Computer Science Research Paper? So, Computer Science Research Paper is the paper which is written by professionals or scientists who are associated to Computer Science and Information Technology, or doing research study in these areas. If you are novel to this field then you can consult about this field from your supervisor or guide.

TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

1. Choosing the topic: In most cases, the topic is searched by the interest of author but it can be also suggested by the guides. You can have several topics and then you can judge that in which topic or subject you are finding yourself most comfortable. This can be done by asking several questions to yourself, like Will I be able to carry our search in this area? Will I find all necessary recourses to accomplish the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

2. Evaluators are human: First thing to remember that evaluators are also human being. They are not only meant for rejecting a paper. They are here to evaluate your paper. So, present your Best.

3. Think Like Evaluators: If you are in a confusion or getting demotivated that your paper will be accepted by evaluators or not, then think and try to evaluate your paper like an Evaluator. Try to understand that what an evaluator wants in your research paper and automatically you will have your answer.

4. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

5. Ask your Guides: If you are having any difficulty in your research, then do not hesitate to share your difficulty to your guide (if you have any). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work then ask the supervisor to help you with the alternative. He might also provide you the list of essential readings.

6. Use of computer is recommended: As you are doing research in the field of Computer Science, then this point is quite obvious.

7. Use right software: Always use good quality software packages. If you are not capable to judge good software then you can lose quality of your paper unknowingly. There are various software programs available to help you, which you can get through Internet.

8. Use the Internet for help: An excellent start for your paper can be by using the Google. It is an excellent search engine, where you can have your doubts resolved. You may also read some answers for the frequent question how to write my research paper or find model research paper. From the internet library you can download books. If you have all required books make important reading selecting and analyzing the specified information. Then put together research paper sketch out.

9. Use and get big pictures: Always use encyclopedias, Wikipedia to get pictures so that you can go into the depth.

10. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right! It is a good habit, which helps to not to lose your continuity. You should always use bookmarks while searching on Internet also, which will make your search easier.

11. Revise what you wrote: When you write anything, always read it, summarize it and then finalize it.



12. Make all efforts: Make all efforts to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in introduction, that what is the need of a particular research paper. Polish your work by good skill of writing and always give an evaluator, what he wants.

13. Have backups: When you are going to do any important thing like making research paper, you should always have backup copies of it either in your computer or in paper. This will help you to not to lose any of your important.

14. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several and unnecessary diagrams will degrade the quality of your paper by creating "hotchpotch." So always, try to make and include those diagrams, which are made by your own to improve readability and understandability of your paper.

15. Use of direct quotes: When you do research relevant to literature, history or current affairs then use of quotes become essential but if study is relevant to science then use of quotes is not preferable.

16. Use proper verb tense: Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

17. Never use online paper: If you are getting any paper on Internet, then never use it as your research paper because it might be possible that evaluator has already seen it or maybe it is outdated version.

18. Pick a good study spot: To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

19. Know what you know: Always try to know, what you know by making objectives. Else, you will be confused and cannot achieve your target.

20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.



27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium through which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

INFORMAL GUIDELINES OF RESEARCH PAPER WRITING

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.



Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

- Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

- Use standard writing style including articles ("a", "the," etc.)
- Keep on paying attention on the research topic of the paper
- Use paragraphs to split each significant point (excluding for the abstract)
- Align the primary line of each section
- Present your points in sound order
- Use present tense to report well accepted
- Use past tense to describe specific results
- Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives
- Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.



Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript-- must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.



- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently. You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.



Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.



ADMINISTRATION RULES LISTED BEFORE SUBMITTING YOUR RESEARCH PAPER TO GLOBAL JOURNALS INC. (US)

Please carefully note down following rules and regulation before submitting your Research Paper to Global Journals Inc. (US):

Segment Draft and Final Research Paper: You have to strictly follow the template of research paper. If it is not done your paper may get rejected.

- The **major constraint** is that you must independently make all content, tables, graphs, and facts that are offered in the paper. You must write each part of the paper wholly on your own. The Peer-reviewers need to identify your own perceptive of the concepts in your own terms. NEVER extract straight from any foundation, and never rephrase someone else's analysis.
- Do not give permission to anyone else to "PROOFREAD" your manuscript.
- **Methods to avoid Plagiarism is applied by us on every paper, if found guilty, you will be blacklisted by all of our collaborated research groups, your institution will be informed for this and strict legal actions will be taken immediately.)**
- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.



CRITERION FOR GRADING A RESEARCH PAPER (COMPILATION)
BY GLOBAL JOURNALS INC. (US)

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals Inc. (US).

Topics	Grades		
	A-B	C-D	E-F
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

INDEX

A

Aforementioned · 11
Arachidonic · 33, 34, 35, 38, 39, 41
Aspergillus · 10, 12, 13, 17

B

Bouyoucos · 12, 15

C

Carboxylase · 8, 9
Chromatography · 30, 40
Cymbopogon · 21, 25, 26

D

Demyelination · 34
Docosahexaenoic · 34, 37, 40

E

Eicosapentaenoic · 34
Emmingham · 13, 15

F

Fungalpopulations · 12
Fungitoxicity · 21, 23

H

Hydrophobicity · 32

M

Mediterranean · 33
Monounsaturated · 32, 33, 42

O

Octosporous · 2

P

Pathogenicity · 21
Phosphatidylcholine · 28, 37
Phosphatidylethanolamine · 37, 41, 45
Photophosphorylation · 5, 6, 8
Potamochoerus · 33, 39
Pycnothyriospores · 2

R

Rhizosphere · 13

S

Scleropyricola · 1

T

Thyriothecia · 2
Triacylglycerols · 33, 41
Trichoderma · 12, 17
Trichosanthes · 21

Z

Zanthoxylum · 21, 25, 26



save our planet



Global Journal of Science Frontier Research

Visit us on the Web at www.GlobalJournals.org | www.JournalofScience.org
or email us at helpdesk@globaljournals.org

ISSN 9755896



© Global Journals