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Tensile Behaviour and Hardness of Coconut Fibre-Ortho Unsaturated Polyester Composites

By Onuegbu T. U., Umoh E.T. & Okoroh N. C.
Nnamdi Azikiwe University

Abstract - This work is aimed at investigating the effect of alkali treatment and fibre load on the tensile properties and hardness of coconut fibre-ortho unsaturated polyester composites. The short length fibres were incorporated into ortho unsaturated polyester resin. The treated and untreated fibre composite samples were subjected to tensile tests according to ASTM D638 using Instron model 3369. The tensile tests include tensile strength, modulus, load at break, tensile strain at break and extension at break. The Micro-hardness test was carried out by forcing a diamond cone indenter into the surface of the hardness specimen to create an indentation. The significant findings of the research showed that alkali treatment improved the tensile properties and hardness of the composite. The tensile properties at 10% fibre load where greatly enhanced while 15% fibre load is best for micro hardness.

Keywords : coconut fibre; composites; hardness; ortho unsaturated polyester; tensile behavior.

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TENSILE BEHAVIOUR AND HARDNESS OF COCONUT FIBRE-ORTHO UNSATURATED POLYESTER COMPOSITES

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Tensile Behaviour and Hardness of Coconut Fibre-Ortho Unsaturated Polyester Composites

Onuegbu T. U. [α], Umoh E.T. [σ] & Okoroh N. C. [ρ]

Abstract - This work is aimed at investigating the effect of alkali treatment and fibre load on the tensile properties and hardness of coconut fibre-ortho unsaturated polyester composites. The short length fibres were incorporated into ortho unsaturated polyester resin. The treated and untreated fibre composite samples were subjected to tensile tests according to ASTM D638 using Instron model 3369. The tensile tests include tensile strength, modulus, load at break, tensile strain at break and extension at break. The Micro-hardness test was carried out by forcing a diamond cone indenter into the surface of the hardness specimen to create an indentation. The significant findings of the research showed that alkali treatment improved the tensile properties and hardness of the composite. The tensile properties at 10% fibre load where greatly enhanced while 15% fibre load is best for micro hardness.

Keywords : coconut fibre; composites; hardness; ortho unsaturated polyester; tensile behavior.

I. Introduction

Fibre Reinforced Polymer (FRP) is a relatively new class of composite material manufactured from fibre and resin and has proven efficient and economical for use in variety of engineering applications in different field such as aerospace, oil, gas and process industries[1]. Composite materials exhibit good resistance to temperature extremes and wear, especially in industrial settings. The tailorability of composites for a specific purpose has been one of its greatest advantages and also one of the more perplexing challenges for adopting them as alternative materials to metallic ones[2].

Thermoplastics or thermosets, can be used as matrix and fibres of various types as reinforcement in fibre reinforced polymer composite. Fibres provide increased stiffness and tensile capacity in the composites giving them their mechanical characteristics [3]. The resin offers high compressive strength and binds the fibres into a firm matrix. Many of our technologies require materials with unusual combination of properties that cannot be met by the conventional metal alloys. The mechanical properties of fibre reinforced polymer composites make them ideal for widespread applications in construction worldwide [4].

The use of natural fibre for the reinforcement of the composites has received increasing attention both by the academic sector and the industry. Natural fibres have many significant advantages over synthetic fibres. Currently, many types of natural fibres have been investigated for use in plastics. These include flax, hemp, jute straw, wood, rice husk, wheat, barley, oats, rye, cane (sugar and bamboo), grass, reeds, kenaf, ramie, oil palm empty fruit bunch, sisal, coir, water, hyacinth, pennywort, kapok, paper mulberry, raphia, banana fibre, pineapple leaf fibre and papyrus[5]. Thermoplastics reinforced with special wood fillers are enjoying rapid growth due to their many advantages; lightweight, reasonable strength and stiffness [6].

Natural fibres, as reinforcement, have recently attracted the attention of researchers because of their advantages over other established materials. They are environmentally friendly, fully biodegradable, abundantly available, renewable, cheap and have low density [7]. Plant fibres are light compared to glass, carbon and aramid fibres [8]. The biodegradability of plant fibres can contribute to a healthy ecosystem while their low cost and high performance fulfils the economic interest of industry.

However, although natural fibres and their composites are environmental friendly and renewable (unlike traditional sources of energy, i.e., coal, oil and gas), they have several bottlenecks. These include: poor wetability, incompatibility with some polymeric matrices and high moisture absorption [9]. Composite materials made with the use of unmodified plant fibres frequently exhibit unsatisfactory mechanical properties. To overcome this, in many cases, a surface treatment or compatibilizing agents need to be used prior to composite fabrication [10]. The properties can be improved both by physical treatments (cold plasma treatment, corona treatment) and chemical treatments (maleic anhydride organosilanes, isocyanates, sodium hydroxide, permanganate and peroxides)[11]. Mechanical properties of natural fibres are much lower than those of glass fibres but their specific properties, especially stiffness, are comparable to the glass fibres [12].Coconut fibre is one of the natural fibres abundantly

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available in tropical regions, and is extracted from the husk of coconut fruit. The common name, scientific name and plant family of coconut fibre is Coir, *Cocos nucifera* and Arecaceae (Palm), respectively [13]. The two types of coconut fibres include brown fibre extracted from matured coconuts and white fibres extracted from immature coconuts. Brown fibres are thick, strong and have high abrasion resistance while white fibres are smoother and finer but weaker. Coconut fibres are commercially available in three forms, namely bristle (long fibres), mattress (relatively short) and decorticated (mixed fibres). These different types of fibres have different uses depending upon the requirement [14]. However, for the purpose of this study, the brown fibres were used.

General advantages of coconut fibres are: they are moth-proof, resistant to fungi and rot, provide excellent insulation against temperature and sound, not easily combustible, flame-retardant, unaffected by moisture and dampness, tough and durable, resilient, springs back to shape even after constant use, totally static free and easy to clean[15]. The aim of this study therefore is to investigate the suitability of coir as reinforcement to polyester resin.

II. Materials and Methods

The brown coir fibre was extracted from the outer shell of matured coconuts harvested from Ballins Farms along College road Abata Nsugbe, Anambra East Local Government Area, Anambra State. Ortho polyester, accelerator, catalyst, as well as the other chemicals used for pretreatment of the fibres were bought from Poly Consult Venture (25 Ogunleti Street), Ojota Lagos.

a) Preparation of the fibre

The brown coconut fibres were pulled out and extracted manually from the coconut stalk. To ensure proper interaction between fibre and matrix material, the outer most wax layer of the coir was removed by soaking the coir in hot water [16].

b) Chemical pretreatment of fibres

The prepared coir fibres were cut into short length fibres of about 5mm to 10mm and divided into 2 separate portions. One portion was chemically pretreated with alkali (NaOH). 200ml of 10% NaOH was used to treat the fibres in a 600ml beaker for one hour. The fibres, were then washed in distilled water and finally dried, in an oven at 80^{0}C for three hours to a constant weight. This was used to prepare the composite. The second portion of the fibres was untreated to serve as control.

c) Preparation of Polyester Composite

The mould was first cleaned with cotton wool dipped in acetone to remove dirt and was allowed to dry. Poly Vinyl Alcohol ($PVA_{(l)}$) was then applied uniformly on the surface of the mould with a short wooden spatula. A thin film of $PVA_{(s)}$ formed on the mould when the PVA dried acted as the mould releasing agent. (Note that the aluminum mould was dismantled to ensure uniform coating of the mould surface and fixed again after it was dried).

The fibre sample and polyester were weighed using the electronic balance. The fibre was mixed with the polyester at room temperature and stirred continuously for 3 minutes until a homogenous mixture was observed. 2% (by weight of polyester) of the catalyst, methyl ethyl ketone peroxide (MEKP) was added using the syringe and stirred continuously for another 3 minutes. Finally, 1% (by weight of polyester) of the accelerator; cobalt octoate was added and stirred for another 3 minutes. The reaction temperature was taken and the composite was cast in the moulds and allowed to cure for one hour. The cured samples were removed from the mould and the overflow flakes were cut off using the small plier. The procedure was repeated for all the fibre volume fraction of 0.05, 0.10, 0.15 and 0.20 and for each sample of fibre viz: the NaOH treated fibre and the untreated fibre. To study the effect of the fibre reinforcement, the unreinforced (zero fibre volume) sample of the polyester was also prepared.

d) Formulation of Fibre-Polyester Composite

Fibre polyester composite were formulated as shown on Table.

Table 1 : Formulation of Fibre-Polyester Composite

Reagents	Weight in Grammes			
Parts by weight of coconut fibre	(5%) 5g	(10%) 10g	(15%) 15g	(20%) 20g
Ortho unsaturated polyester	95.0	90.0	85.0	80.0
Methyl ethyl ketone peroxide (MEKP)	1.90	1.80	1.70	1.60
Accelerator – Cobalt Octoate	0.95	0.90	0.85	0.80
Reaction Temperature (^{0}C)	44	43	41	41
Curing Temperature (^{0}C)	45	43	42	42

e) Characterization of the samples

i. *Tensile Tests*

Test for tensile properties were carried out as described in American Standard Testing and Measurement (ASTM) method D638, using the Instron universal testing machine at crosshead speed of 10mm/min using dumbbell test piece. Each tensile specimen was positioned in the Instron universal tester and then subjected to tensile load, as the specimen stretched the computer generated the graph as well as all the desired parameters until the specimen fractured. A graph of tensile stress versus tensile strain was plotted automatically by the computer.

ii. *Micro hardness test*

The Micro-hardness test was carried out by forcing a diamond cone indenter into the surface of the

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Hardness specimento create an impression (indentation). Three hardness values were obtained for each specimen and the values were summed up to get an average for each specimen. The experiment was performed with the use of micro hardness tester.

III. Results and Discussion

a) *Tensile properties of the composites*

The test results of tensile properties of treated and untreated composite sample are as show in Tables 2 & 3, Fig. 1 – 5.

Table 2 : Tensile Results for Treated Fibre Composites

Property	0%	5%	10%	15%	20%
Tensile Strength (Mpa)	28.388	14.270	21.852	14.235	8.059
Modulus (Mpa)	856.849	553.871	815.343	667.635	594.841
Load at Break (N)	1082.634	509.169	912.690	584.982	107.479
Tensile Strain at Break (mm/mm)	0.0423	0.0413	0.0415	0.0399	0.0102
Extension at Break (mm)	4.117	3.328	2.324	2.345	2.569

Table 3 : Tensile Results for Untreated Fibre Composites

Property	0%	5%	10%	15%	20%
Tensile Strength (Mpa)	28.388	12.126	17.763	11.667	6.038
Modulus (Mpa)	856.849	595.895	726.422	397.773	349.263
Load at Break (N)	1082.634	510.508	728.593	478.829	287.659
TensileStrainatBreak(mm/mm)	0.0423	0.03684	0.0421	0.0456	0.0284
Exetension at Break (mm)	4.117	2.119	2.356	3.0274	2.2455

From Tables 2 and 3, the major determinants of the strength of material were plotted against the fibre load.

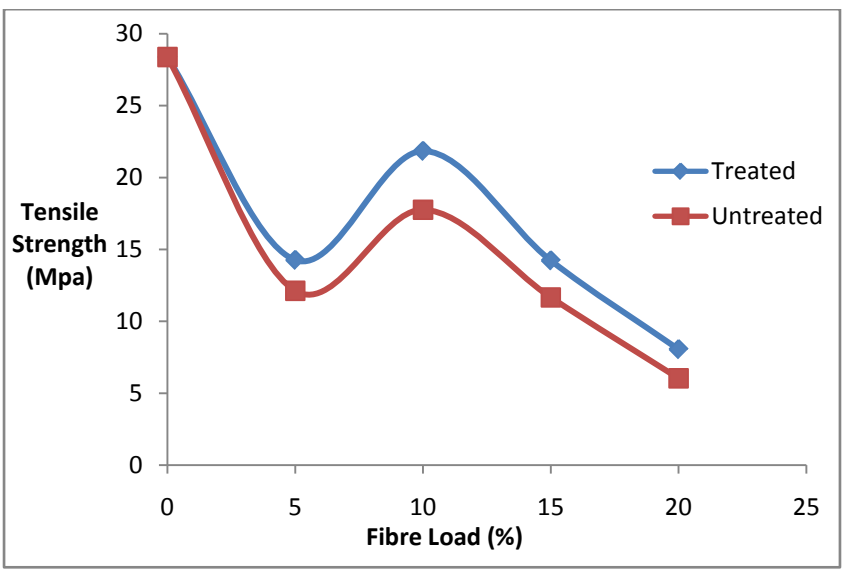

Figure 1 : Effect of Treatment on Tensile Strength

Fig. 1 shows a comparison of the tensile strengths of the composites using various loads of treated and untreated fibres. The treated fibre at low fibre load of 5% has a tensile strength of 2.144Mpa higher than the untreated fibre. At 10% fibre load, the tensile strength of the treated increased by 4.089Mpa against that of untreated. 2.568Mpa at 15% fibre load and at 20% fibre load the tensile strength of the treated has 2.021Mpa higher than that of the untreated. Thus, sodium hydroxide treatment can be seen to have caused a substantial increase in the tensile strength of the composite.

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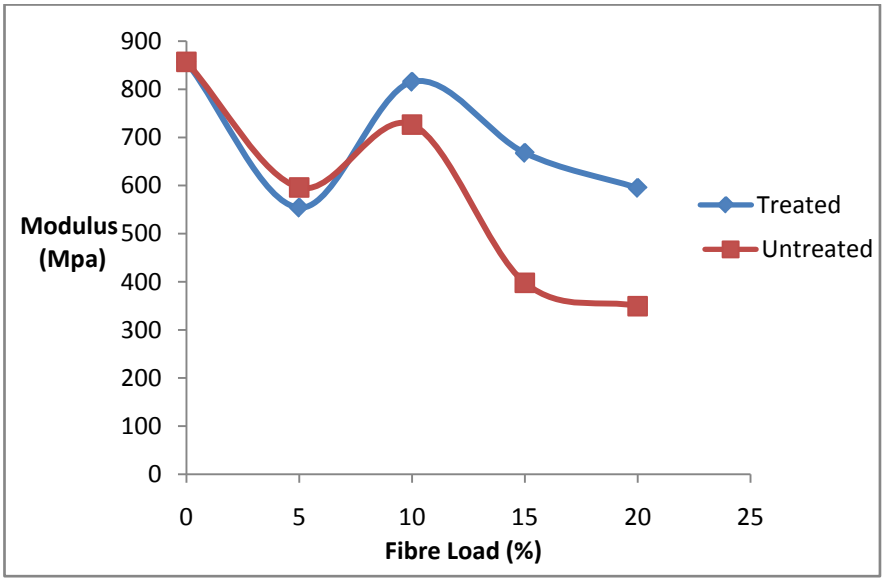

Figure 2 : Effect of Treatment on Modulus

From Fig. 2, the composites of treated and untreated fibres show remarkable differences in their modulus which is a measure of stiffness and resistance to stress. At 5% fibre load, it is observed that the untreated fibre has a modulus which is 42.024Mpa higher than the treated fibre. However, as the fibre load increases to 10%, 15% and 20% the modulus of the treated fibre composite becomes higher than the untreated fibre composite by 88.921Mpa, 269.867Mpa and 245.578Mpa respectively.

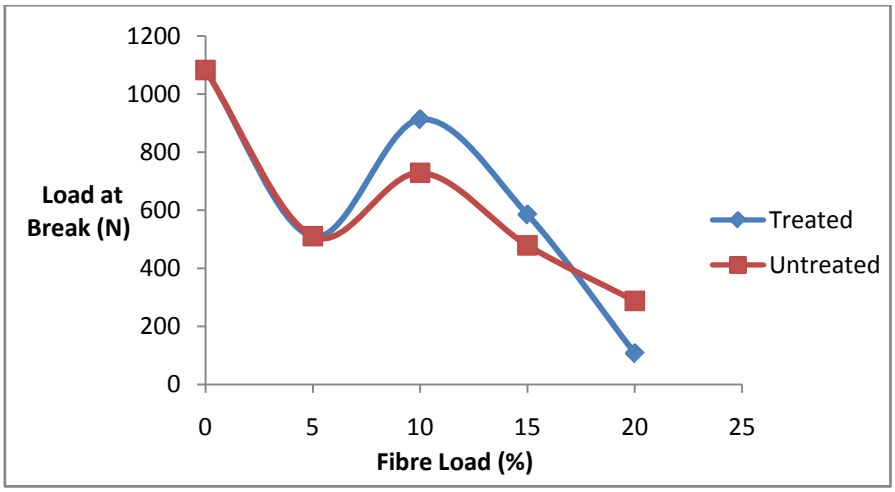

Figure 3 : Effect of Treatment on Load at Break

From Fig. 3, the graph shows that at 5% volume ratio, the load at break for treated and untreated fibre composite are slightly the same. But at 10% and 15% fibre load, the treated fibre composite has a higher load at break while at 20% fibre load, the untreated fibre has a higher load at break.

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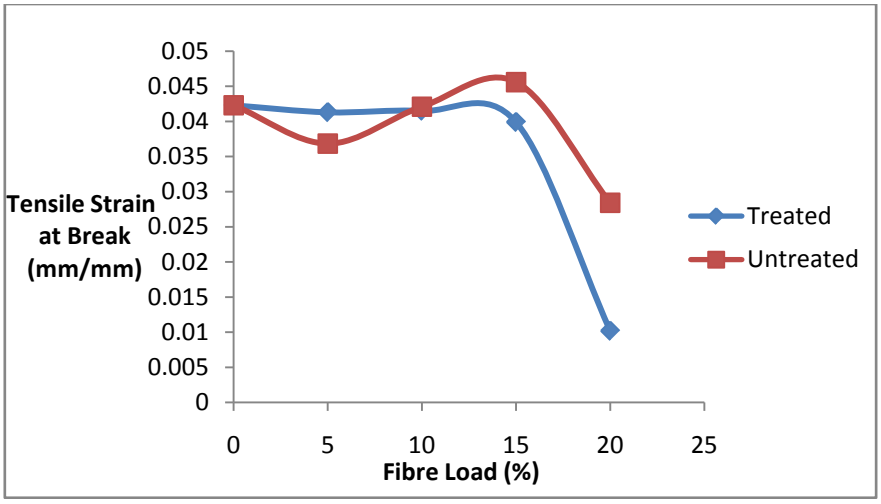

Figure 4 : Effect of Treatment on Tensile Strain at Break

Fig 4 shows also that the tensile strain at break on the composite is least on the treated fibre composite between 10% fibre loading and 20% fibre loading. This implies that permanent deformation is least detected on the treated fibre composite and mostly pronounced on the untreated fibre composite. However, at lower volume ratio of 5%, the treated fibre composite is more prone to permanent deformation when compared with the untreated fibre composite which has a lower value of tensile strain at break.

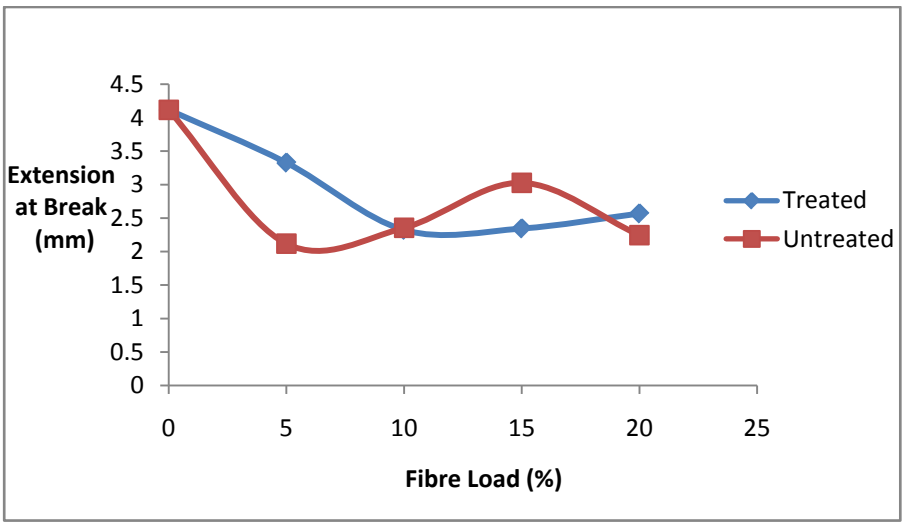

Figure 5 : Effect of Treatment on Extension at Break

Fig. 5 shows the effect of treatment on the extension at break of the treated and untreated fibre composites. Extension at break is a measure of the ductility of the composite. It can be observed from the graph that between 5% and 10% fibre load, the treated fibre composite has higher ductility than the untreated fibre composite. However, as the fibre load increases to 15%, the untreated fibre has a ductility which is 29.08% higher than the treated fibre composite while at 20% fibre load, the ductility of the treated fibre composite is 14.43% higher than that of the untreated fibre composite.

b) Micro Hardness Properties of the Composites

Test results for micro hardness are shown in Table 4 and Fig 6.

Table 4 : Micro Hardness for Treated and Untreated Fibre Composites

Sample	Untreated sample (HV)	Treated sample (HV)
0%	22.06667	22.06667
5%	18.13333	21.46667
10%	24.16667	26.46667
15%	15.23333	37.76667
20%	13.76667	26.36667

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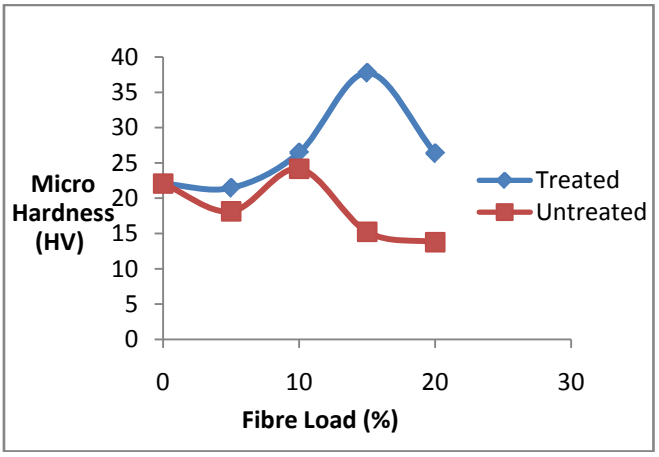

Figure 6 : Effect of Fibre Load and Treatment on Micro Hardness

From Fig. 6 above, it can be seen that treatment as well as increase in volume ratio improves the micro hardness of the fibre composite. While the treated fibre composite sample at 15% fibre load has the highest value, the untreated fibre composite sample at 20% fibre load has the least value.

IV. Conclusion

From the results genenerated, it can be established that NaOH pretreatment of coconut fibre has better reinforcing property than the untreated fibre. The treatment was observed to improve the tensile properties (tensile strength, modulus, load at break, tensile strain at break, extension at break) and micro hardness of the composite samples.

For tensile properties, 10% fibre load gave the best reinforcing property for treated fibre composites while 15% fibre load samples exhibited the best micro hardness.

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Assessment of Effect of Sewage Intrusion from Septic Tanks into the Consumable Hand Dug Wells in Lagos State, Nigeria

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Abstract - Access to a regular supply of safe water is a basic human right but many people are denied. This study investigated the physical, chemical and microbiological properties of well water installed close to septic tank in some location in Lagos metropolis. Samples were collected from five (5) wells from each location (Ikorodu, Mushin, Shomolu, Itire and Ilasamaja) during the rainy season when ground water intrusion is high. The well water were analyzed for pH, temperature, Total Solid, Dissolved Solid, Suspended Solid, Alkalinity, Acidity, Total Hardness, Dissolved Oxygen, Biological Oxygen Demand, Chemical Oxygen Demand, Sulphate, Manganese, Cadmium, Zinc (Zn), Total coliform count and Total Bacteria count. pH, temperature, TS were determined immediately in the sample. Analysis of the heavy metals was done using Flame Atomic Absorption Spectrophotometer. Data obtained were subjected to descriptive statistics.

Keywords : quality assessment; well; septic tank.

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ASSESSMENT OF EFFECT OF SEWAGE INTRUSION FROM SEPTIC TANKS INTO THE CONSUMABLE HAND DUG WELLS IN LAGOS STATE, NIGERIA

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Assessment of Effect of Sewage Intrusion from Septic Tanks into the Consumable Hand Dug Wells in Lagos State, Nigeria

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Abstract - Access to a regular supply of safe water is a basic human right but many people are denied. This study investigated the physical, chemical and microbiological properties of well water installed close to septic tank in some location in Lagos metropolis. Samples were collected from five (5) wells from each location (Ikorodu, Mushin, Shomolu, Itire and Ilasamaja) during the rainy season when ground water intrusion is high. The well water were analyzed for pH, temperature, Total Solid, Dissolved Solid, Suspended Solid, Alkalinity, Acidity, Total Hardness, Dissolved Oxygen, Biological Oxygen Demand, Chemical Oxygen Demand, Sulphate, Manganese, Cadmium, Zinc (Zn), Total coliform count and Total Bacteria count. pH, temperature, TS were determined immediately in the sample. Analysis of the heavy metals was done using Flame Atomic Absorption Spectrophotometer. Data obtained were subjected to descriptive statistics. All the physical, chemical and microbial properties investigated except pH, Total Solid, DO, BOD and the coliform and bacteria count in the sampled well water were within the specified limit of WHO and hence, not suitable for domestic purposes for which they are presently used for in some of the residential area in the study area. Contamination from intrusion from septic tanks and runoff from storm water could account for these differences in sampled water and WHO Limits. Where affordable, water must be treated before consumption and Public enlightenment on water quality should be encouraged to foretell the looming danger from water contamination/pollution.

Keywords : quality assessment; well; septic tank.

I. Introduction

The importance of safe water in social economic development cannot be overemphasized. Water is essential to all forms of life. It is second in ranking, next to air in the list of human daily needs (NEST, 1991). Without water, humans cannot live for more than a few days. Water is in great demand (Aderogba, 2005) as it represents a unique feature in every settlement: for drinking, sanitation, washing, fishing, recreation and industrial processes. Assess to clean and regular water supply is a basic human right as is access to unadulterated food. A lot of people especially the less affluent however miss out on this as with other human rights Worldwide, about 2 billion people struggle daily for access to clean and sufficient water (Adepoju-Bello and Alabi, 2005) and Africa suffers most from inadequate access to water supply with only 62% of the population having access to potable water supply. In Nigeria in particular, more than 55% of population does not have access to safe drinking water and consequently leading to high rate of infant mortality. In order to meet this huge shortfall in the daily water demand, groundwater is considered a better complementary source as a result of modest cost. However, the problem associate with groundwater exploration is that intrusion of polluted water from solid waste landfills, on-site excreta disposal system and agricultural waste that recharges the wells used by household (Mendie, 2005). These as led to health risks which is synonymous with the study area. Therefore, it becomes imperative to investigate the effect of sewage intrusion from septic tank into the nearby consumable hand dug wells in some areas of Lagos metropolis.

II. Study Area

The Ikorodu, Mushin, Shomolu, Itire and Ilasamaja are among the major urban centre in Lagos metropolis. The Lagos metropolis is located in Lagos State, Southwest Nigeria. Lagos The study area has a typical tropical climate, which is marked by two prominent seasons. The rainy season extends generally from March to November with intermittent dry spells. This is the period when the southwesterly wind prevails. The dry season usually occurs from December and March when the area is under the influence of the northeasterly wind. The Lagos metropolis and its environs are typical of the country's Southern zone with relatively moderate temperature and fairly excessive humidity particularly during the rainy season. The average annual rainfall in Study Area is about 1500 mm. The average slope of natural drainage lines in the present undeveloped regions of the study area is about 1:10,000. Unfortunately, some of these natural drainage lines have been blocked by development in the eastern coastal areas, resulting in the creation of large swamps and a rise in the groundwater table in the neighboring undeveloped areas. The study area consists of outcrops

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coastal areas, resulting in the creation of large swamps and a rise in the groundwater table in the neighboring undeveloped areas. The study area consists of outcrops of two main geological formations. The coastal plain sands which form the low, gently sloping dissected uplands, reaching in places a height of 6 to about 30 meters, and the recent coastal deposits which form the extensive and swampy alluvial plains of the major rivers and creeks along the coast overlying the coastal plain sands.

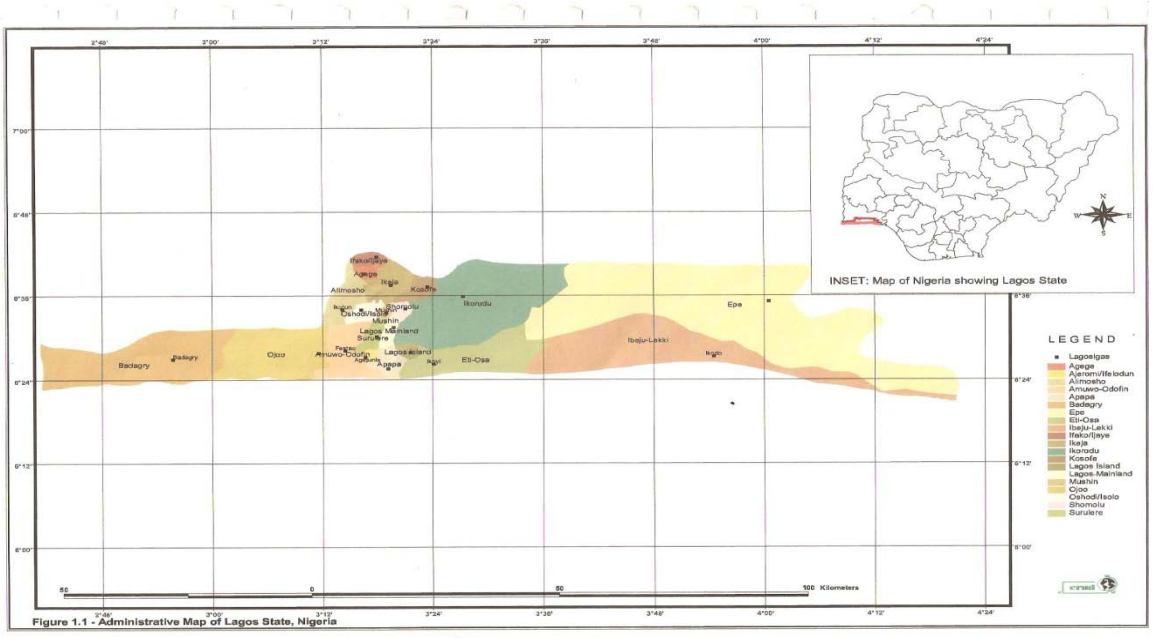

Figure 1 : Map of Lagos State Showing Project Site Location

III. Material and Method

Five water samples each randomly selected in study areas were analyzed for physical, chemical and microbiological parameters from hand dug wells from the five selected locations during the rainy season when ground water intrusion is high. The well water samples were collected following standard procedure for sampling. The choice of the sampling points was based on closeness to septic tanks and the choice of the sampling locations was based on population density of area. The samples were transported in ice chests to the different laboratories where they were either analyzed immediately or stored at 40°C or less to monitor the present status of source pollution indicative parameters. Standard laboratory methods and descriptive statistics were employed for the analysis.

IV. Results and Discussion

The physical, chemical and microbiological properties of hand dug wells in the some selected locations in Lagos metropolis were presented in Tables 1. Values obtained in this study were compared with the World Health organization standard.

Table 1 : Water physical, chemical and microbiological analysis of hand dug wells in the some selected locations in Lagos metropolis

Parameters	Ikorodu Mean	Mushin Mean	Shomolu Mean	Itire Mean	Ilasamaja Mean	WHO Limit
Appearance insitu	Clear	Clear	Clear	Clear	Clear	Clear
Temperature °C	27.5	27	27	27.5	27	20-33
pH	4.59	5.76	6.48	3.92	6.70	6.5-8.5
Dissolved solid	804.0	360.0	322.0	723.0	630.0	2000
Total Solid (mg/l)	990.0	440.0	430.0	810.0	700.0	200.0
SuspendedSolid (mg/l)	186.0	80.0	108.0	78.0	70.0	200.0
Alkalinity (mg/l)	27.0	54.0	18.0	9.0	48.0	NS
Acidity (mg/l)	32.0	44.8	41.6	51.2	25.6	NS
Total Hardness (mg/l)	98.0	112.0	220.0	106.0	326.0	NS
DO (mg/l)	8.3	3.96	3.02	7.16	2.50	<2.0

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BOD (mg/l)	24.5	13.0	71.6	52.8	82.9	15
COD (mg/l)	41.8	35.6	65.0	57.4	75.3	80
Sulphate (mg/l)	25.3	90.9	26.8	107.0	49.4	500
Manganese (mg/l)	0.286	0.213	0.300	0.313	0.148	50
Cadmium (mg/l)	0.1	0.07	0.08	0.1	0.2	<1
Zinc (mg/l)	0.1	0.1	0.2	0.2	0.1	<1
Total coliform count (ml)	80	60	45	50	50	0 per 100ml
Total bacteria count (ml)	$5.0 * 10^3$	$4.5 * 10^3$	$2.4 * 10^3$	$4.0 * 10^3$	$2.6 * 10^3$	0 per 100ml

The results of the analysis indicate clear water in all well water sampled, though some level of contamination were identified in some parameters sampled. Results showed that all parameters except pH, Total Solid, DO, BOD and the coliform and bacteria count in the sampled well water were within the specified limit of WHO (Fig.2) and hence, not suitable for domestic purposes for which they are presently used for in some of the residential area in the study area. Contamination from intrusion from septic tanks and runoff from storm water could account for these differences in sampled water and WHO Limits. More than 92% of tested samples contain detectable amount of pH, Total Solid, DO, BOD and the coliform and bacteria count with concentration above the maximum contaminant level suggested by WHO.

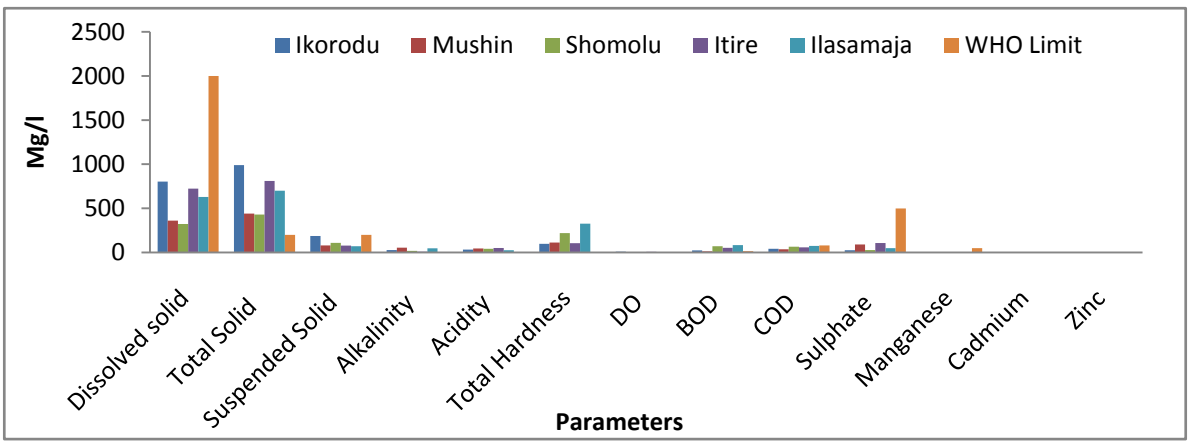

Figure 2 : Graph showing the some physical and chemical parameters levels in well water samples

Temperature of well water followed a distinct pattern reflecting no variability of the atmospheric temperature. The temperature range is between 27 and 27.5^{O}C which fall in the limit of 20-33°C of WHO as shown in Fig.3.

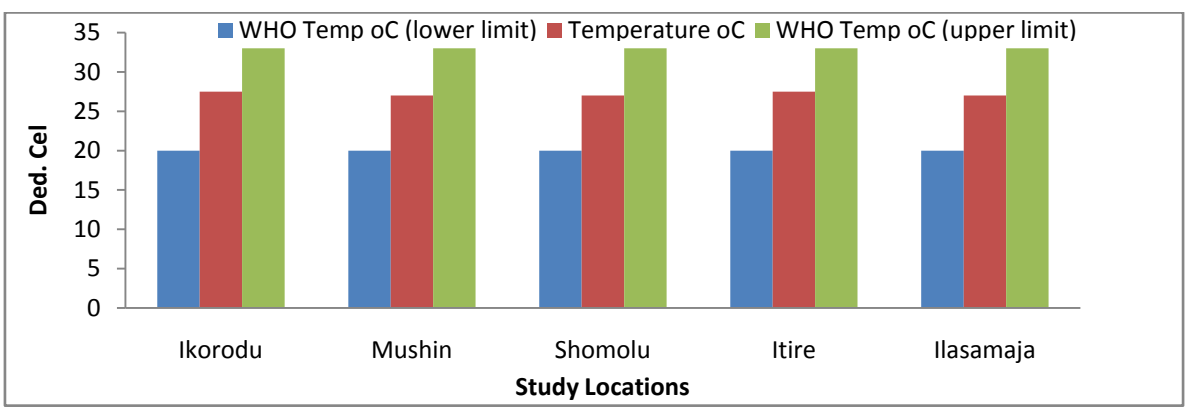

Figure 3 : Temperature levels in well water samples

The pH of sampled well water varied considerably from that of the WHO Limits and did not follow any pattern (Fig. 4) while some of the values fell within the range (6.5 – 8.5) stipulated by the WHO for drinking water quality, others did not. These were not accepted as they fall below 5.7 and rendering them

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acidic. The effects of acidic water on human health and the environment have been widely reported. For example, acidic water has been known to be aggressive and enhance the dissolution of iron and manganese, causes unpleasant taste in water (Hammer and Hammer, 2004).

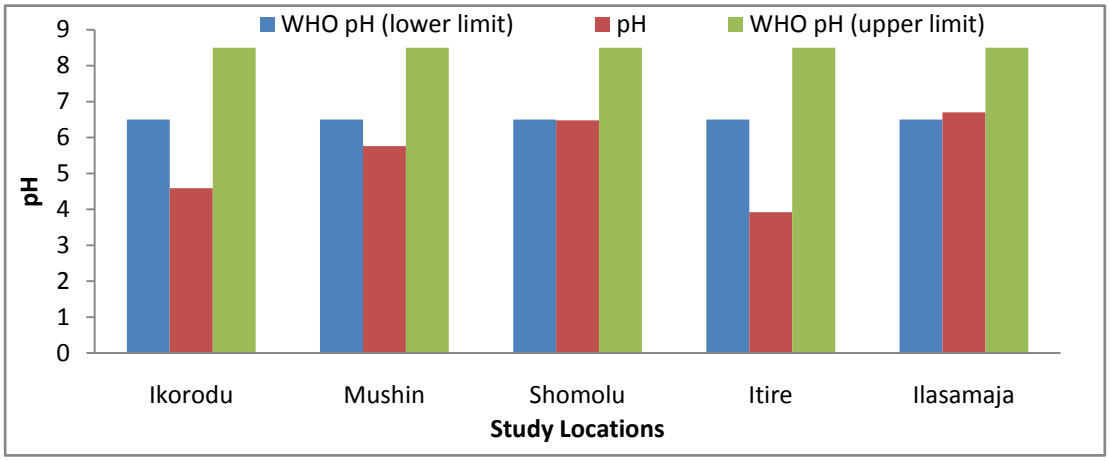

Figure 4 : pH levels in well water samples

The Total solid of well water sampled ranges from 430 mg/l-990 mg/l (Fig. 5). This is of concern because the total solid measures the amount of dissolved salts in the water (Salinity) which is a good indication of contamination or low quality of water. According to most authors, these are strongly associated with particles in runoffs (Akhter *et al.*, 2002). The values generally are more than the MCL of 500ppm, but it implication is that it impair the water quality and affect the clarity of water. High concentration of total solid could result to salty and unpalatable taste in water. High concentration of total solid could also result to gastrointestinal irritation.

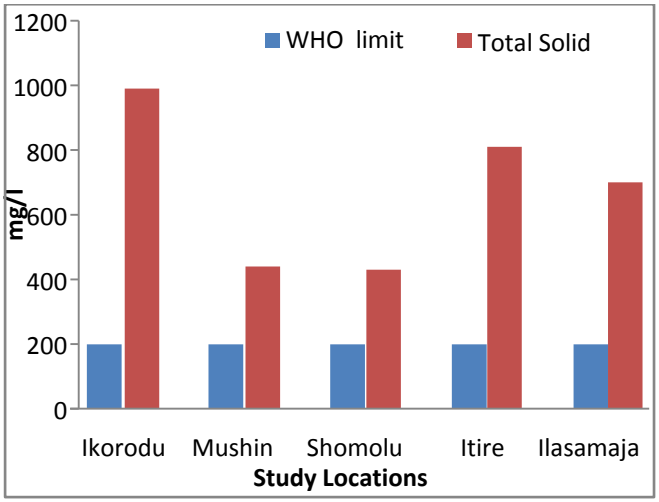

Figure 5 : Total solid levels in well water samples

Furthermore, the result showed that all well water sampled contained high organic pollutants such as Dissolved oxygen (DO) and Biological oxygen demand (BOD). They ranged from of 2.5 mg/l- 8.3 mg/l and 13.0 mg/l- 82.9 mg/l, respectively as against 2 and 15mg/l specified by WHO (Fig. 6).

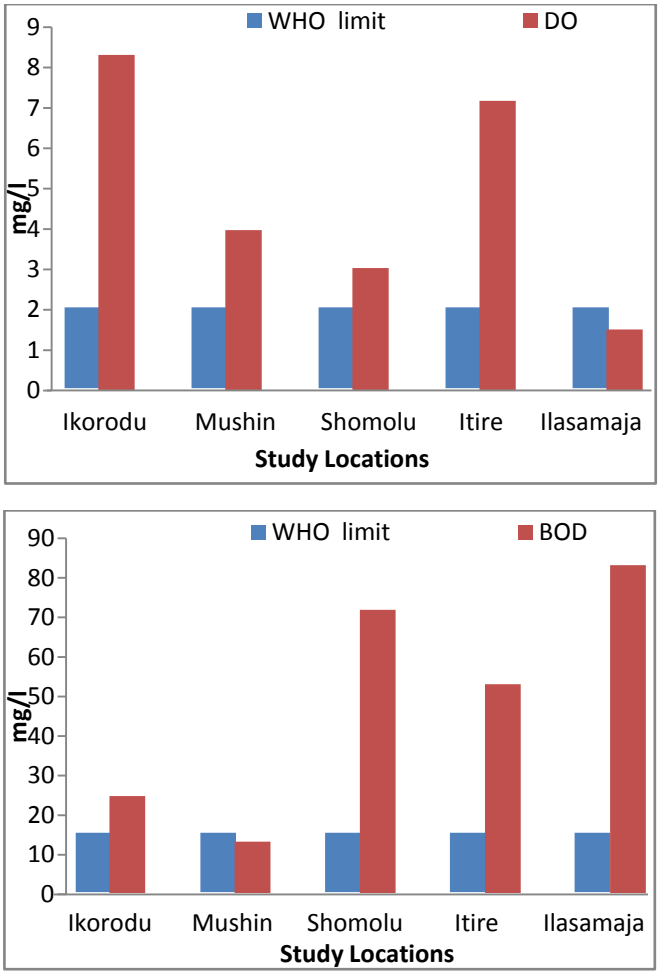

Figure 6 : Organic pollutants (DO and BOD) levels in well water samples

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The Total coliform and bacteria count of sampled well water were more than the WHO specified limits. Total coliform count in the sampled locations ranged between 45 ml – 80 ml compared to a count range of 2.4 x 10^3 ml– 5.0 x 10^3 ml in the total bacteria cunt. The highest Total coliform and bacteria count was observed in Ikorodu (Fig. 7). This could be as a result of closeness of location to water bodies.

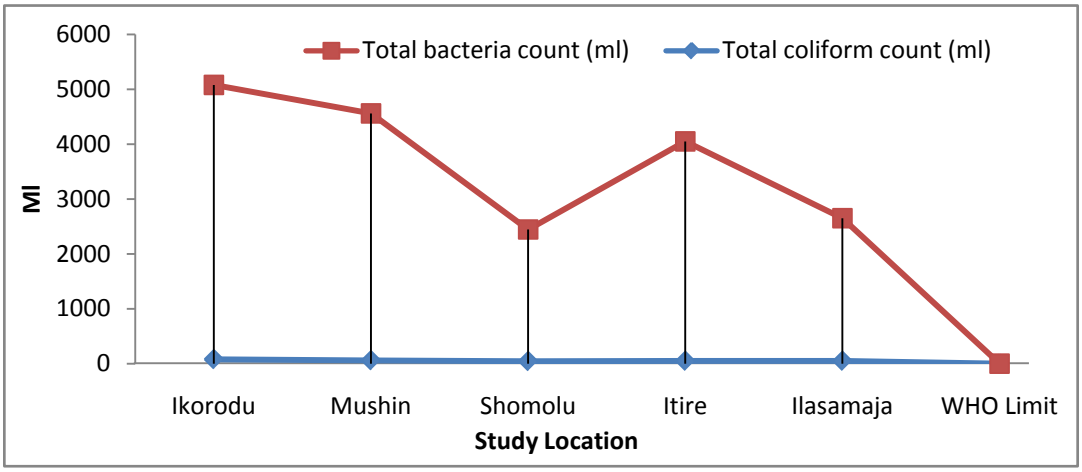

Figure 7 : Microbial (Total coliform and bacteria count) levels in well water samples

V. Conclusion

A preliminary and periodic assessment of well water located close to sewage tanks is essential as they could contain substance that may be harmful. In this study, sewages tank closeness to wells were observed to impact more on the pH, Total Solid, DO, BOD and the coliform and bacteria count content of water, where affordable, water must be treated before consumption and Public enlightenment on water quality should be encourage to foretell the looming danger from water contamination/pollution.

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Abstract - Textile industries release large amounts of wastewater at risk of toxicity. Shells could be alternative adsorbent materials both economic and less polluting. To highlight the process of adsorption of dyes on Mytilus Edulis shells, a model, based on an analytical method was applied to the case of spherical samples. The theoretical, results fo the kinetics of dye transfer were in good agreement with the corresponding experimental ones. The Spherical model exhibited a significant dye transfer, controlled by diffusion with different diffusivity an a coefficient of matter transfer characterizing the retardation in the transfer on the surface.

Keywords : indigo carmine, methylene blue, spherical form, modeling of process, transient diffusion.

GJSFR-B Classification : FOR Code: 091406, 040309

DETERMINATION OF INTRAPARTICLE DIFFUSIVITY OF DYE ADSORPTION PROCESS ONTO MYTILUS EDULIS SHELLS

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I. Introduction

Synthetic organic dyes are compounds used in many industries such as automotive, chemical especially the textile sector, or any range of shades and chemical families are represented. The affinities between textiles and dyes vary the chemical structure of dyes and fiber type on which they are applied. It is not uncommon to find that during the dyeing process from 15 to 20% of the dyes, and sometimes up to 40% for sulfuric dyes and reagents, are evacuated with effluents liquids that are mostly directly discharged into rivers without treatment.

Coloured discharges pose a cosmetic problem, but also health because many of these dyes are toxic. Like all organic compounds hazardous to humans, synthetic dyes require specific treatments. Many kinds of adsorbents have been developed for various applications [1–3]. However, the conventional method used by treatment plants wastewater is difficult and sometimes not even suitable for the remediation of these pollutants biocides.

A processing technique suitable for discharge from the textile industry must first achieve performance when citrate is a mixed effluent. It is why the adsorption process (multi adsorption) on activated carbon, is the method most used and recommended for the treatment of wastewater in industries textiles.

Despite its effectiveness, Charbon is an expensive material asset and mostly imported, and the material asset and mostly imported, and the search for new products that come from a source cheap and available, is useful.

We are interested in the properties of the adsorbed shells of mussels that could be used in the treatment of discharges from the textile industry. The use of shells in a new treatment process within a framework of sustainable development, the social aspect and environemental, but we must also consider the economic the general interest objective in the long term is threefold: reduce pollution, promote recycling and waste waters.

II. Theoretical And Experimental Part

a) Assumptions

The following assumptions were made: (i) The sample was spherical in shape, (ii) The spherical sample was not modified during the test, as shown by experiments, (iii) The de transfer was controlled by diffusion under transient conditions, with a constant diffusivity, (iv) The liquid transfer into the sample was not considered, and (v) a coefficient characterizing the dye transfer through the liquid-sample interface was introduced in the paper.

b) Mathematical Treatment

Fick's laws describing the matter transfer by diffusion were considered, for the case of a spherical sample with a constant diffusivity [4]:

$$j = -D.\frac{\partial C}{\partial x}$$

$$\frac{\partial C}{\partial t} = D\left[\frac{\partial^2 C}{\partial r^2} + \frac{2}{r}.\frac{\partial C}{\partial r}\right] \quad (1)$$

$$= \frac{1}{r^2}.\frac{\partial}{\partial r}\left[D.r^2.\frac{\partial C}{\partial r}\right] \quad (2)$$

III. Results And Discussions

After having determined the data useful for calculation, i.e. the diffusivity and the coefficient of

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matter transfer at the surface of the sample, the model was built and then tested by comparing the kinetics of dye transfer into the support obtained either from experiment or from calculation.

a) Determination of KInetic Parameters

It was difficult to determine the diffusivity corresponding with the transfer of drug by using short tests [8] because of the presence of the coefficient of matter transfer. So, we calculated this parameter by using the data obtained from experiments for very long times and the Equation 5.

The initial and boundary conditions were described by equations 3 and 4:

$$t=00 \leq r < RC=0 \quad (3)$$

$$t> 00 \leq r \leq RC=C_{éq}=C_0 \quad (4)$$

Analytical solutions could be found for the simple case when the diffusivity was constant, and the concentration of dye on the surface of sample was zero as soon as it was soaked in the liquid [5,6].

$$\frac{M_\infty - M_t}{M_\infty} = \frac{6}{\pi^2}.\sum_{n=1}^{\infty}\frac{1}{n^2}.\exp\left(-\frac{n^2.\pi^2.D.t}{R^2}\right) \quad (5)$$

Where M_t and M_∞ was the amount of dye released at time t and at infinite time, respectively, R was the radius of the sphere, n was an integer.

The series shown in equation 5 was available for long and short tests, for very short tests, a simple equation was used [7].

$$\frac{M_t}{M_\infty} = \frac{1}{6}.\left(\frac{D.t}{\pi}\right)^{0,5} \quad (6)$$

b) Methylene Blue Diffusivity

To test the validity of the expression of the intra-particle diffusion already demonstrated, the evolution of Ln [1 / (1-F ² t)] versus time was plotted. In all cases, the plot of Ln [1 / (1- F ² t)] versus time applied properly to methylene blue dye diffusion is shown at figure 1. The results of simplified model application.

c) Indigo Carmine Diffusivity

In the same, to test the validity of the expression of the intra-particle diffusion already demonstrated, the evolution of Ln [1 / (1-F ² t)] versus time was plotted, the plot of Ln [1 / (1- F ² t)] versus time is applied properly to indigo carmine dye diffusion is shown at figure 2.

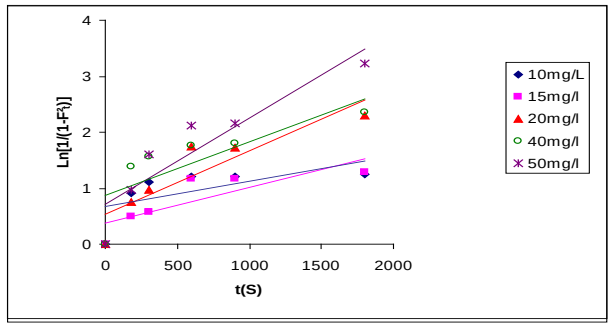

Figure 1 : Vermeulen intraparticle model for methylene blue adsorption onto Mytilus Edulis shells

Table 1 : Results of application of the simplified model of internal diffusion Vermeulen for methylene blue adsorption onto Mytilus Edulis shells

C_0 mg/l)	r^2	$K_V(s^{-1}) = (\pi^2 D/R^2)$	$D(m^2.s^{-1})$
10	0,9833	0,0273	$2,42.\ 10^{-12}$
15	0,9806	0,0381	$3,38.\ 10^{-12}$
20	0,8	0,068	$6,03.\ 10^{-12}$
40	0,9174	0,071	$6,3.\ 10^{-12}$
50	0,8359	0,0925	$8,2.\ 10^{-12}$

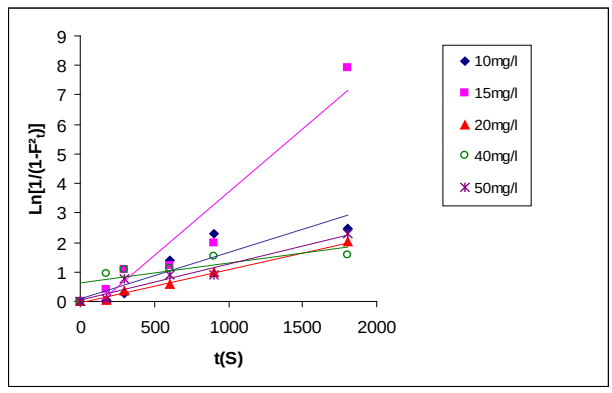

Figure 2 : Vermeulen intraparticle model for indigo carmine adsorption onto Mytilus Edulis shells

Table 2 : Results of application of the simplified model of internal diffusion Vermeulen for indigo carmine adsorption onto Mytilus Edulis shells

C_0 (mg/l)	r^2	$K_V(s^{-1}) = (\pi^2 D/R^2_a)$	$D(m^2.s^{-1})$
10	0,8221	0,0939	$8,3.\ 10^{-12}$
15	0,9201	0,0958	$8,5.\ 10^{-12}$
20	0,9918	0,1685	$1,49.\ 10^{-11}$
40	0,8978	0,1704	$1,51.\ 10^{-11}$
50	0,9331	0,1728	$1,53.\ 10^{-11}$

IV. Conclusion

We have shown in particular that it was possible to adsorb dyes in the shells of mussels Mytilus Edulis previously untreated.

A model, based on a numerical method with finite differences, was built by considering that the

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samples were spherical in shape. The dye transfer was found to be controlled by diffusion under transient conditions with different diffusivity and with a coefficient of matter transfer at the liquid- material interface.

$K_V=\pi^2D/R^2a$ increment depends on the concentration of the colored solution D = f (C_0), it increases with increasing concentration and diffusivity·

The kinetics of dye transfer obtained by experiments and calculation were in good agreement, proving the validity of the model.

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Amino Acid Analysis and Preliminary Toxicological Evaluation of Garcinia Mangostana Seed Cake in Albino Rats

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Abstract - The amino acid analysis and preliminary toxicological effect of *Garcinia mangostana* seed cake on albino rats have been investigated in order to determine its suitability as an additive in feed supplement. The proximate analysis of the seed cake showed that it had a high carbohydrate value of 71.02 ± 0.79% but low protein, moisture, fat and ash contents of 8.09 ± 0.21%, 10.42 ± 1.12%, 2.13 ± 0.13% and 1.8 ± 0.02% respectively.The seed cake also contains manganese, calcium, potassium, sodium, magnesium, iron, copper and zinc. The result of the phytochemical analysis revealed that *Garcinia mangostana* seed cake contains tannins, flavonoids and alkaloids. Among the seventeen amino acid determined in the defatted seed, glutamate gave the highest concentration of 10.94 g/100g. During the rat experiment which lasted for six weeks, both the control and test rats appeared to suffer no toxicological effect and weekly monitoring showed good physical appearance.

Keywords : amino acid; garcinia mangostana; mineral element; proximate; phytochemical; toxicological effect.

GJSFR-B Classification: FOR Code: 070204, 110101

AMINO ACID ANALYSIS AND PRELIMINARY TOXICOLOGICAL EVALUATION OF GARCINIA MANGOSTANA SEED CAKE IN ALBINO RATS

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Ibironke A. Ajayi [α], Emmanuel Ifedi [σ] & Vivian N. Aghanu [ρ]

Abstract - The amino acid analysis and preliminary toxicological effect of *Garcinia mangostana* seed cake on albino rats have been investigated in order to determine its suitability as an additive in feed supplement. The proximate analysis of the seed cake showed that it had a high carbohydrate value of 71.02 ± 0.79% but low protein, moisture, fat and ash contents of 8.09 ± 0.21%, 10.42 ± 1.12%, 2.13 ± 0.13% and 1.8 ± 0.02% respectively.The seed cake also contains manganese, calcium, potassium, sodium, magnesium, iron, copper and zinc. The result of the phytochemical analysis revealed that *Garcinia mangostana* seed cake contains tannins, flavonoids and alkaloids. Among the seventeen amino acid determined in the defatted seed, glutamate gave the highest concentration of 10.94 g/100g. During the rat experiment which lasted for six weeks, both the control and test rats appeared to suffer no toxicological effect and weekly monitoring showed good physical appearance. There was no significant difference between the control and test groups for the haematology and histopathology examination of sections of the heart, liver, kidney, spleen, lung, intestine and brain result.

Keywords : amino acid; Garcinia mangostana; Mineral element; proximate; phytochemical; toxicological effect.

I. Introduction

Garcinia *mangostana*, a Clusiaceas, commonly known as mangosteen and one of the most universal recognized tropical fruit, has universal appeal because of its quality in colour, shape and flavour. It is a tropical evergreen tree originated from South East Asia, probably Malaysia; it can also be seen in India, Myammer, Philippine, Srilanka, Thailand and even in Nigeria. The tree can reach 6–25 m and has leathery, glaborous leaves and is slow to grow (Morton, 1987). The fruits are dark purple or reddish with white soft and juicy edible pulp with a slightly acid and sweet flavor and a pleasant aroma (Jung *et al.*, 2006). The white juicy edible pulp also has high sugar content (Kanchanapoom and Kanchanapoom, 1998; Plartin, 1980 and Nakasone and Paul, 1998). *G. mangostana* is also known as "Queen of Fruit" because it is one of the best tasting tropical fruits. The timber is dark brown, rather hard and heavy and the inner dark yellowish petioles of *G. mangostana* tree are short and thick. The flowers are 5 cm in diameters, four parted bisexual and borne singles or in pairs at the end of the branchlets. The seeds are large, flattened and embedded in snow white or pinkish delicious pulp botanically called "aril" edible flesh which can be described as sweet, tangy, citrusy with peach flavor and texture (Abbiw, 1990). The fruit mangosteen is rated as one of the most delectable of the tropics and the pulp gives the fruits its reputation as one of the finest and most delicious of fruits. Good fruits may attain 6–7 cm in diameter and contain 5–7 seeds surrounding a white, sweet and succulent flesh (Burkill *et al.*, 1994). *G. mangostana* is an emerging category of novel functional foods sometimes called super fruit presumed to have a combination of appealing subject characteristics such as taste, fragrance, visual qualities, nutrient richness, antioxidant strength (Primchamien, 2004) and potential impact for lowering risk of human diseases (Jose *et al.*, 2008) and the pericarp is widely useful. *G. mangostana* has some medicinal properties; it possesses antitumor, antimicrobial, antifungal, anti-inflammatory and antioxidative properties (Chairrrungsri *et al.*, 1996).

We are living in a world where maximum utilization of natural resources is the ultimate goal. Currently, there is little information on the *Garcinia mangostana* seed cake. The seed is neither eaten nor used for any industrial purposes in Nigeria. Apart from the chemical composition of *G. mangostana* seed and its oil and the preliminary toxicological evaluation of the oil carried out by Ajayi *et al.*, 2007, there is no literature report on the defatted seeds hence the need for this research. The aim of this work, therefore, is to determine the amino acid and mineral element composition, carry out phytochemical screening, and evaluate the toxicological effect of using defatted *G. mangostana* seeds as feed supplement in albino rat feed.

II. Materials and Methods

a) Materials

Garcinia mangostana fruits used for this work were collected from the Botanical Garden of the University of Ibadan; Oyo State, Nigeria. The seeds were removed from the fruits, washed with water and left to air dry for two days.

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University of Ibadan; Oyo State, Nigeria. The seeds were removed from the fruits, washed with water and left to air dry for two days.

b) Sample Preparation

The seeds of *G. mangostana* were decorticated manually and grounded into a paste using a previously cleaned and dried mortar and pestle. The paste was then stored in an air tight container for analysis.

c) Preparation of Defatted Garcinia Mangostana

The mangostana oil was extracted by a solvent extraction method using hexane (bp 40-60 °C) in a soxhlet extractor. *Garcinia mangostana* seed cake (GMSC) remaining after the oil extraction was air dried, pulverized and passed through a 200 mesh size to obtain the defatted powder which was used as experimental material.

d) Proximate Analysis

Percentage moisture, crude fat, ash and crude fibre contents of *G. mangostana* seed cake were determined following the methods of Association of Official Analytical Chemists (AOAC, 2006). Nitrogen content of the seed cake was estimated using the micro-kjeldahl method as described by AOAC (1984) and crude protein was calculated (N x 6.25). Carbohydrate contents were determined by difference [100 - (moisture + protein + crude fat + ash + crude fiber)].

e) Analysis of Mineral Elements

0.5 g of GMSC was digested with 20 ml mixture of concentrated HNO^3 and perchloric acid (2:1 v/v) until the solution became a clean one. Thereafter, it was transferred to a 100 ml volumetric flask and diluted. It was made up to the mark with deionized water and stored in a clean polyethylene bottle. The mineral element content was determined using an atomic absorption spectrophotometer (Perkin–Elmer model 703, USA) as described by Onyeike and Acheru (2002).

f) Amino Acid Analysis

The seed cake was hydrolysed in 6M HCl at 105 °C for 22 hours in nitrogen flush. The hydrolysate was further analysed for amino acids using the sequential multi-sample amino acid analyzer as described by Spackman *et al.* (1958). The chromatogram of the sample was compared using norleucine as a standard.

g) Phytochemical Analysis

The phytochemical screening for the presence of saponins, tannins, alkaloids, flavonoid, steroid and glycoside were carried out according to the methods describe by Trease and Evans (1983) and Hassan *et al.* (2004).

h) Experimental Animals

Fourteen albino rats (aged 8 weeks; weighing between 105-115 g) were obtained from the Physiology Department, University of Ibadan, Nigeria. The rats were divided into 2 groups of 7 rats per group named A and B for control and experimental group respectively. During the 6 weeks period of the experiment, the rats in the control group were fed the basal diet only while the ones in the experimental group were fed a diet in which 7.08% of GMSC was used to totally replace corn bran. All the rats were fed *ad libitum* and they had unrestricted access to drinking water. The feed intake and body weight gain was noted every week (Leontowicz *et al.*, 2007).

i) Feed Compoundment

A basal diet was formulated to meet the entire nutrient requirement for young albino rat of 8 weeks (*Rattus norvegius*). GMSC was used to totally replaced corn bran in the diet formulated. The diets were prepared according to the procedure described by Souza *et al.*, (2007) with slight modification. The basic ingredients used were 2800.0 g of maize, 1274.7 g of soy bean, 231.0 g of calcium, 55.3 g of salt, 994.0 g of groundnut cake, 495.6 g of palm kernel cake, 495.6 g of wheat, 495.6 g of corn bran and 158.2 g of oyster shell for the control diet with 495.6 g of GMSC replacing corn bran in the experimental diet (Table 1). Ingredients of the diets were mixed thoroughly with the mixing machine to obtain a homogenous mixture which was pelletized and packed into two different transparent sterile plastic containers.

j) Blood Sample and Tissue Collection

At the end of the feeding period, the rats were fasted over night. Blood sample was immediately collected from the eye into bottles containing EDTA to prevent blood coagulation, and then, they were harvested. In one part of the blood, the haematological studies was carried out and to the other part, serum was separated by centrifugation. The tissues collected were kidney, heart, spleen, lungs, small intestine, brain and liver. These organs were weighed immediately after collection and preserved in formalin for pathology studies.

k) Haematological Examination

The packed cell volume (PCV), haemoglobin (Hb) concentration, red blood cell (RBC) and white blood cell (WBC) counts were determined using the standard techniques described by Dacie and Lewis (1991) and Jain (1986). The differential WBC counts mean corpuscular volume (MCV) and mean corpuscular haemoglobin concentration (MCHC) were calculated (Jain, 1986).

l) Tissue Pathology

The internal organs were exposed by dissection and the liver, spleen, kidney and lungs were observed for gross lesions. Small portions of each organ already stored in formalin were fixed and put through timed series of dehydration in graded concentrations of

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xylene. They were embedded in wax, sectioned at 5μ and transferred on to clean glass slide. The thin sections were stained with haematoxylin and eosin (H and E) dye for examination under light microscope for histological changes (Jain, 1986).

m) Statistical Analysis

Data are expressed as the means and standard errors of five separate contents, except for fatty acid. They were statistically analysed by 2-way analysis of variance (ANOVA) and means were compared by Duncan's multiple range test (Duncan, 1955) at 5 % level of significance.

III. Result and Discussion

a) Proximate Composition

The result of proximate analysis of GMSC is shown in Table 2 below. The ash content is 2.13±0.03% and the crude fibre content was found to be 6.49± 0.01%. The carbohydrate content is very high, 71.02 ± 0.79%. This high carbohydrate content and crude fibre value suggest that the seeds could serve as source oh roughage and the suitability of compounding it in animal feeds, (Abighor *et al*, 1997).

The protein content of GMSC is very low 8.09 ± 0.01%. It is lower in comparison to the values (11-27.8± 0.04%) reported for wheat flour and defatted wheat germ flour (Muhammad *et al* 2007) and falls within the range of (6-12%) reported for conventional cookies (Shrestha & Noomhorm, 2002). The ash content, 2.13 ± 0.03% is lower than the value reported for *A. heterophyllus* and *T. africana* (Ajayi, 2008), and greater than the values determined for seeds such as kolanut, coconut and melon seeds (Onyeike&Acheru, 2002). Addition of GMSC resulted in an increase in the ash values of the feed compounded up to 6.79± 0.02%, crude fibre content up to 17.73 ± 0.31% and fat content up to 9.79 ± 0.02%.

b) Mineral Element Composition

Table 3 shows the mineral elements that were analysed using atomic absorption spectrophotometer on the acid digest of the defatted *Garcinia mangostana*. The result of metal composition indicates that, defatted *Garcinia mangostana* flow has high level of potassium (270 mg/L), followed by magnesium (110 mg/L), followed by iron (68.62 mg/L), and calcium (30 mg/L). Potassium is an essential mineral element which helps to regulate blood pressure, while calcium is needed for bone growth and muscle concentration. Magnesium works with calcium to maintain healthy bones and hearth. Feed compounded with GMSC will help to prevent deficiency of potassium, magnesium, iron and calcium since the seed are rich in these element (Ajayi *et al*., 2007). *Garcinia mangostana* seed cake can be a good source of iron and slightly manganese. These minerals in the diet are generally required for metabolic reactions, transmission of nerve impulse and rigid bone formation among others (Egwin *et al*., 2010).

c) Phytochemical Analysis Results

Phytochemical results suggested that carbohydrate, alkaloids tannins and flavonoids can be isolated from *G. mangostana* seed cake. The result revealed that GMSC contains an array of phytochemicals which include carbohydrate, tannins, flavonoids, alkaloids and glycosides (Table4). Saponins, steroids and terpenoids, were not observed. It is important to note that phytochemical constituent can help one to speculate on the medicinal value of the seed (Oladosu *et al*., 2011). Tannins and alkaloids have been reported to have pronounced physiological effect particularly on the nervous system (Oladosu *et al*., 2011). The presence of flavonoids in GMSC suggests that the seed plant is pharmacologically active, supporting the claim by traditional healers. This result obtained is comparable to the reported phytochemical components which indicate the presence of alkaloids and flavonoids in *Coffea genus* (Simkin *et al*., 2008; Koshio *et al*., 2006; Andrade *et al*., 1998) and also in *Coffee brivipes* extract (Oladosu *et al*., 2011).

d) Amino acid results

Among the17 amino acids determined in GMSC (Table 5), glutamate gave the highest concentration of 10.938 g/100g followed by cystine 9.144 g/100g, aspatate 8.942 g/100g, leucine 6.292 g/100g and arginine 6.285 g/100g. Etonihu *et al*. (2009) stated that glutamate (14.64 g/100g), aspartate (9.85 g/100g), phenylalanine (6.85 g/100g) and arginine (6.38 g/100g) were the major constituents of amino acid in pigeon pea proteins while for defatted wheat germ, Muhammed *et al*. (2007) found glutamate, aspartate, argenine, cystine and leucine to be 5.09 g/100g, 1.63 g/100g, 4.76 g/100g, 0.00 g/100g, and 1.11 g/100g respectively.

e) Physical Appearance

Generally, the rats maintained fine and smooth hairs all trough. There was no significant smell except that of their urine. Both the control and experimental group have the normal rats smell. It was important to note that no mortality was recorded throughout the period of this work.

f) Weight Changes

i. *Body and Feeds Weight Changes*

Figs. 1 and 2 show the body weight changes and the feed intake per week of rats in both the test and control groups. There were positive weight changes in each group within the period of this study. In group A, the weight increased from 114.29 ±9.75 to 148 ± 5.53 while in group B, it increased from 107.14 ± 20.58 to 152.86 ± 7.55. It is an indication of the desirability of the diet. Rats in group B displayed fairly similar body weight gain to that in group A as there was no much significant

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difference between the body weight gains of the two groups. This could be attributed to the feed intake. In the case of the feed intake, there was positive increase in each group, the feed intake increased from 715 g to 835 g and from730 g to 960 g for group A and group B respectively. The difference may be due to the nutrient content of defatted *G. mangostana*. The feed intake obtained in this study was a little bit higher than 625g reported by Ajayi *et al.* (2007) on rats fed with *Garcinia mangostana* seed oil. The result is also similar to the report given by (Longvah *et al.*, 2000) for rat fed with groundnut and Perilla oil.

ii. *Organ Weight Changes*

Table 6 shows the organ weights of test and control rats for six weeks experiment. The organs whose weights were noted were liver, kidney, heart, lungs, intestine, brain and spleen. The liver weight obtained in groups A and B (4.25 ± 0.68 and 4.01 ± 0.37) respectively is similar to the report given by Vishnu *et al.* (2010) where the control group was 4.1 ± 0.26 and the test group ranged from 3.94 ± 0.94 to 4.01 ± 0.31. Vishnu *et al.* (2010) found also no significant difference between the control group and various dose of *G. mangostana* pericarp applied on rat. The values of heart, brain, and lungs: 0.5 ± 0.00, 1.5 ± 0.00 and 0.92 ±0.37 respectively obtained in group A are similar to the weight in group B.

g) Haematological Analysis Results

Table 7 shows the result of haematological analysis of *G. mangostana* seed cake on rats. The parameters obtained for rats in group A and group B were comparable. Haemoglobin concentration in group B (14.35 ±0.35) is significantly different to that of Group A (13.88 ± 0.62). Bienat *et al.* (1997) obtained 13.88 ± 0.1 for diet without cholesterol addition of *Oenothra paradoxa* seed oil. Vishnu *et al.* (2010) obtained a concentration ranging from 13.83 ±0.98 to 14.12 ± 0.41 for *G.mangostana* pericarp extracts in rats at 1g/kg, 2g/kg, and 3g/kg respectively. The MCV concentration in groups A and B are very comparable (60.32 ± 1.40 and 5907 ± 0.81. WBC in group B was 4750 ± 1240 which is lower to that in group A, 5591.67 ± 2218. A high value ranging from 8050 ± 330.9 to 8633 ±513.3 was obtained by Ajayi *et al.* (2007). Since the haematological parameters obtained from rats fed with *Garcinia mangostana* seed cake compared favourably with the values obtained with the rats fed with normal feed (control group), it indicates that GMSC has no advert effect on the blood of the test rats.

h) Histopathological Result

The pathology result showed no major complications and no significant differences on the tissues of the rats in both groups (Table 8).

IV. Conclusion

Based on the proximate analysis results obtained from this study, *Garcinia mangostana* seed cake showed a high value for carbohydrate content but it is low in crude protein and crude fibre. It can be utilized for roughage in feed for live stock because of the high value of carbohydrate and can be supplemented with other high protein residue, such as groundnut cake. The phytochemical analyses showed the presence of tannins, flavonoids and alkaloids which ascertain that *Garcinia mangostana* seed cake contains some major compounds that have remarkable biological activities, and might be helpful in preventing various diseases. Defatted *G. mangostana* contains Fe, Zn, Mg, Na, Cu, K, Mn and Ca, among which Fe and Mn concentration are high but Fe has the highest value. These metals are all useful in making the body strong. *Garcinia mangostana* seed cake did not produce any significant change of haematological parameters as well as in the heart of the rats in both groups. The seed cake might be a good additive in feed supplement.

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Table 1: Ingredient compositions of basal diet for rats in the control and experimental groups

Item (%)	Control group	Experimental group
Maize	40	40
Soy bean	18.21	18.21
Dicalcium phosphate(Bone)	3.30	3.30
Salt	0.79	0.79
Groundnut cake	14.2	14.2
Corn bran[a]/GMSC[b]	7.08	7.08
Palm kernel cake	7.08	7.08
Wheat	7.08	7.08
Oyster shell	2.26	2.26

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Table 2: Results of proximate analysis[a] of GMSC, control and experimental groups

Parameter (%)	GMSC	Control group	Experimental group
Moisture content	10.47±1.12	9.26±0.5	8.51±0.03
Crude protein	8.09±0.01	6.32±0.11	6.19±0.18
Crude fibre	6.49±0.01	22.11±0.03	17.73±0.31
Fat content	1.80±0.02	9.73±0.01	9.79±0.02
Ash content	2.13±0.03	7.21±0.05	6.25±0.08
Carbohydrate content	71.02±0.79	45.37±0.43	55.53±0.02

[a]Values are expressed as mean±SD for triplicate results

Table 3: Metal composition of GMSC

Metal	Concentration (mg/L)
Calcium	30
Magnesium	110
Potassium	270
Copper	6.58
Sodium	7.95
Manganese	9.76
Zinc	25.63
Iron	68.62

Table 4: Result of Phytochemical screening of GMSC

Parameter	Result
Saponins	-
Flavonoids	+
Alkaloids	+
Cardiac glycosides	+
Steroids	-
Carbohydrate	+
Terpenoids	-
Phenol	-
Tannins	-

Table 5: Amino acid content of GMSC

Amino acid	Content (g/100g)
Glycine	2.761
Alanine	3.251
Serine	4.227
Proline	2.571
Valine	4.429
Threonine	3.145
Isoleucine	3.879
Leucine	6.292
Aspartate	8.942
Lysine	5.341
Glutamate	10.938
Methionine	1.626
Phenylalanine	3.868
Histidine	1.954
Arginine	6.285
Tyrosine	3.640
Cystine	9.144e-1

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Table 6: Weight of tissues[a] (g)

Tissue	Control group	Experimental group
Liver	4.25±0.68	4.01±0.37
Kidney	0.75±0.27	0.91±0.20
Heart	0.50±0.00	0.50±0.00
Lungs	1.00±0.00	0.92±0.37
Intestine	1.33±0.25	1.33±0.40
Spleen	0.50±0.00	0.50±0.00
Brain	1.41±0.20	1.50±0.00

[a]*Values are expressed as mean ± SD for weights of six rats (n=6)*

Table 7: Results of Haematological analysis of control and experimental rats

Parameter	Control group	Experimental group
PVC	42.17±2.63a	43.00±0.63a
Hb	13.88±0.88a	14.35±0.35b
RBC	6.99±0.43a	7.28±0.10a
WBC	5791.67±2218a	4750±1240a
MCV	60.32±1.40a	59.07±0.81a
MCHC (%)	32.92±0.68a	33.36±0.41a
MCH	19.86±0.64a	19.70±0.71a
Lymphocyte (%)	69.33±5.53a	61.33±8.10a
Neutrophyl (%)	28.17±4.95a	36.67±8.32a
Eosinophyl (%	0.00±0.00a	0.33±0.05b
Monocyte (%)	2.17±2.13a	1.67±1.03a
Absolute Lymphocyte	3994.58±1913a	2956±999.17b
Absolute Neutrophyl	1575.00±446.24a	1699.58±490.19a
Absolute Eosinophyl	0.00±0.00a	17.92±27.81b
Absolute Monocyte	127.58±125.01a	77.83±56.28b

Table 8: Histo-pathological examination of control and test rat tissues

Tissue	Control group	Experimental group
Heart	No visible lesion	No visible lesion
Brain	The endothelial cells are swollen and prominent.	The endothelial cells are swollen and prominent.
Lung	There is moderate thickening of the of the interalveolar septae by proliferation of pneumonocytes	There is a moderately proliferative thickening of the alveolar septae.
Liver	No visible lesion	No visible lesion
Kidney	The renal blood vessels are moderately congested.	There are few focal aggregates of informatory cells (mostly neutrophils) within the renal interstitium
Intestine	There are few locally extensive foci of necrotic surface epithelial cells.	There is an intraluminal parasite(likely to be a flat worm)

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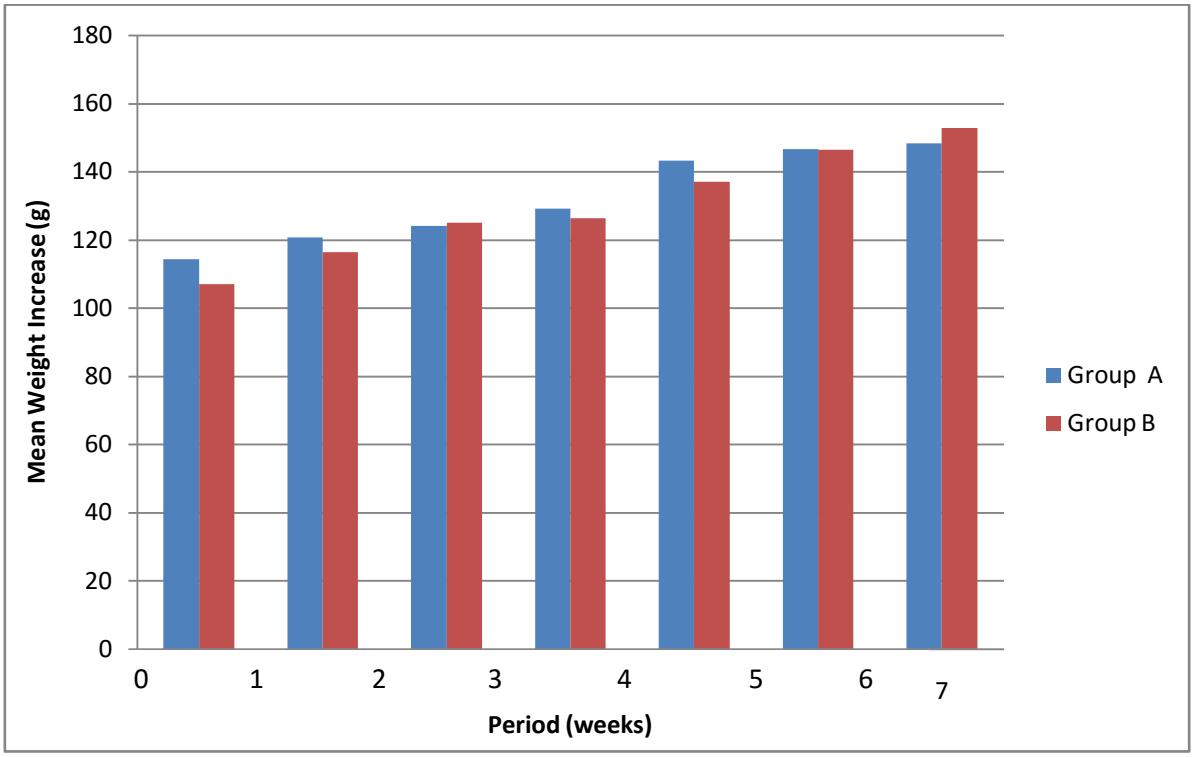

Figure 1: Pictogram of body weight increase of control and test rats

A: Control group with normal feed, B: Defatted *Garcinia mangostana* seed group

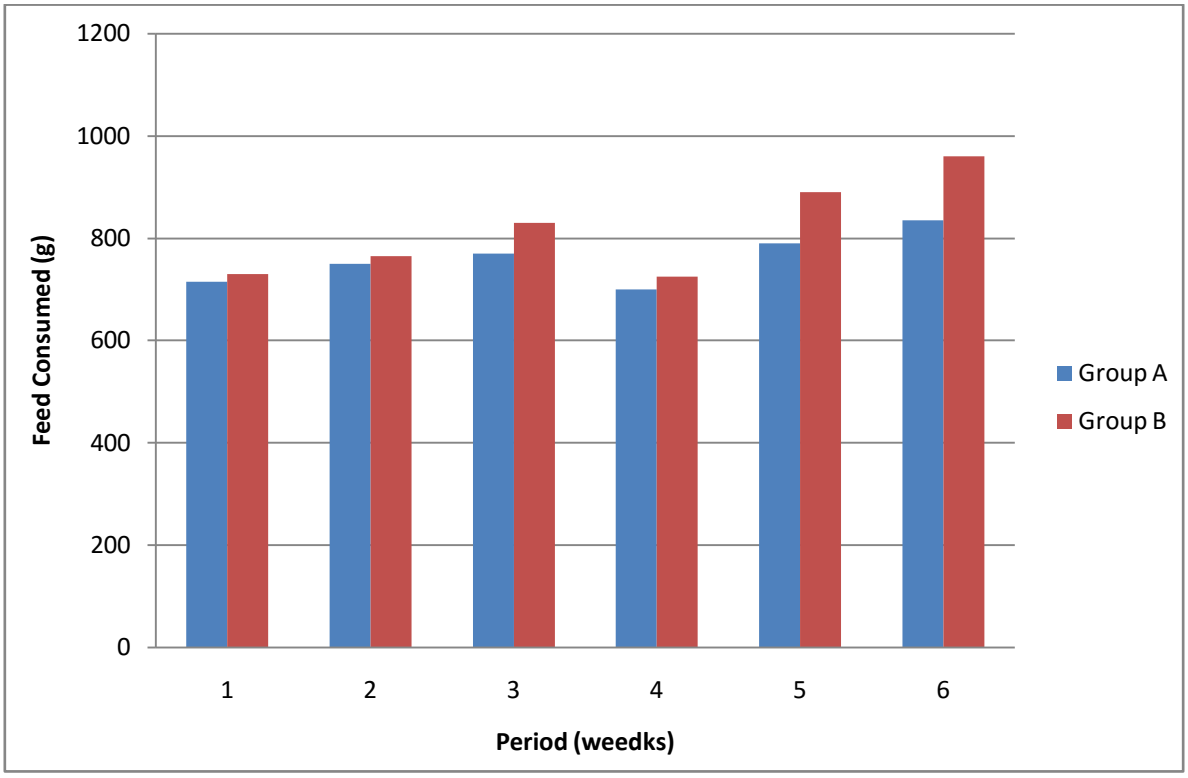

Figure 2: Pictogram of feed intake per week of control and test rats

A: Control group with normal feed, B: Defatted *Garcinia mangostana* seed group

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- 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.

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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.

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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.

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TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

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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.

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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.

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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 though 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

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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.

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- 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.
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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.

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- 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

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- 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.

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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

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