CHEMICAL COMPOSIITON OF SELECTED LOCALLY BLENDED POULTRY FEEDS MARKETED IN ABA ABIA STATE NIGERIA

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ABSTRACT

Evaluation of the chemical composition of poultry feeds for major nutrients is one of the most important considerations in the field of poultry production. The current research evaluated the nutrient, anti-nutrient phytochemical, antioxidant and heavy metal composition of selected locally blended poultry feeds finishers marketed in Osisioma LGA of Abia State Nigeria. The collected samples were processed and analyzed using standard analytical procedures and the data obtained were subjected to analysis of variance (ANOVA). The result indicated that there is significant ($p<0.05$) differences among the feeds (LBF1, LBF2 and LBF3) in the nutrient composition. LBF3 feed had the highest ether extract (5.91± 0.84)) crude fiber (8.2-± 0.79) and ash content (6.05± thank you.48) LBF1 feed had the highest crude protein content (9.85± 1.26) and the least ash content (5.20± 0.58). However, there was no significant ($p>0.05$) differences among the feeds in terms of anti-nutrient and phytochemical contents. Similarly, heavy metal profiles were not significantly ($p>0.05$) different among the feeds evaluated. The crude protein analyzed were below the nutrient requirement standard of broiler birds which indicated a minimum range of 19-21%. In order to enhance growth and productivity, these feeds must be supplemented with good protein feed ingredients so as to satisfy birds, nutrient requirement.

Keywords: Poultry feed, heavy metal, nutrient and anti-nutrient composition

INTRODUCTION

The demand for chicken eggs and poultry meats in Nigeria have placed constant pressure on the poultry production sector (Alizadeh *et al.,* 2016). Subsequently, the commercial poultry farmers are faced, with several major problems which include the increasing cost of feeds and marketing of poultry products for profitability. The cost of feeds has increased over the past few years due to scarcity of the ingredients diseases and the competition between man and animals for the limited available ingredient (Abudabos, 2012).

Several studies have revealed that, due to the increases in human populations and consequent high

cost and demand for poultry feeds, it has become increasingly necessary to substitute these feed ingredients with other cereal and legume crop residues so as to reduce the competition between man and livestock (Denstadli *et al.,* 2010).

The trend in which cereal and legume crop residues were considered as waste has changed and is now being used extensively for animal feeds. Most of the cereal and legume crop residues are low in nutritive value and high in fiber content, therefore if not adjusted via supplementation it may lead to reduction in the performance of birds.

Apart from supplementations, bioavailability of nutrients is an important factor affecting performance of birds.

Compounds that interfere with the intake, availability or metabolism of nutrients in animal are referred to as anti-nutritional factors (Ramteke *et al.,* 2019; Parpinelli *et al.,* 2018). Their biological effects can range from mild reduction in animal performance to death. Studies have shown that foodstuffs contain several anti-nutritional factors in variable amounts and their negative effects can be overcome by using appropriate technology (Johnson *et al.,* 2022, Parpinelli *et al.,* 2018). Similarity, the exposure of these foodstuffs to various environmental pollutant such as heavy metals have also been reported Thorns 2000. Stein *et al.,* 2008). Heavy metals apply to the group of metals and metalloids that are toxic or poisonous at low concentrations (Ukpabi *et al.,* 2013). The poisoning effects of heavy metals are due to their interferences on regulatory enzymes and on the cellular macronutrients via free radical formation. While certain mineral elements are essential dietary nutrients they can as well have serious effect on organisms if included in the diet at excessively high concentrations. Understanding the nutritive composition of these feeds would aid in selecting cereal and legume crop residues as feedstuffs by farmer. Therefore, this study was designed to evaluate the chemical composition (nutrients, anti-nutrients and heavy metals profile) of selected locally blended poultry feeds marketed in Aba Abia State Nigeria.

MATERIALS AND METHODS

Site of study The study was carried out at the laboratory section of the Department of Biochemistry Abia State Polytechnic, Aba, Abia State Nigeria.

SAMPLE COLLECTION AND PREPARATION

Three brands of finishers feeds were bought from Ahiakwo market at Aba-Owerri Road in Osisioma LGA Aba. The feed samples were purposely selected based on their low-price levels.

The feeds were shade dried, sieved with a 2mm mesh size and sealed in air tight plastic containers and then stored in the laboratory for analysis. The nutrient, anti-nutrient antioxidant heavy metal and phytochemical analyses of the samples were carried out at the Biochemistry laboratory of Abia State Polytechnic, Aba.

Sample Analysis

Nutrient Analysis

The nutrient analysis of feed samples were carried out in accordance with the methods describe by the AOAC (2015).

MOISTURE CONTENT

The moisture content of all samples were measured as described by AOAC method (AOAC, 1980). Crucibles were thoroughly washed and dried in an oven at 100^0C for 30min and allow to cool inside desiccators. After cooling, they were weighed as W1. Then, 2.0g of the finely ground feed samples were put into crucibles and weighed as W2. Thereafter, the sample plus the crucibles were placed inside the oven and dried at 100^0C for 4hours, cooled and weighed at the same temperature for 30minutes until constant

were obtained as W3. Then, the moisture content of the feed samples was calculated.

Moisture (%) = (W2 – W3)/(W2-W1) x 100

Where, W1 = Initial weight of empty crucible,

W_2 = Weight of crucible + sample before drying

W_3 = final weighing of crucible + sample after drying

DRY MATTER COMPOSITION

A known weight (2.0g) of the feed samples were carefully weighed into a foil paper of known weight then transferred into the oven for 48hrs till a known and stable weight is obtained. It is then cooled in the desiccator. The new weight in obtained and is expressed as a percentage of the original sample.

% DM =

$$\frac{\text{weight of sample} - \text{weight of oven dried sample} \times 100}{\text{Weight of sample}}$$

ASH DETERMINATION

A known weight (2.0g) of the dried feed samples were weighed into a crucible of known weight and was carried over a flame and then ignited in the moffle furnance at 600^{0}C for 30minutes then cooled in the desiccator and weighed. The residue after the ignition in the furnance is the ash and it is expressed as

$$\%\text{Ash} = \frac{\text{Crucible with ash-crucible} \times 100}{\text{Weight of sample}}$$

CRUDE PROTEIN DETERMINATION

A known weight (2.0g) of the dried feed samples were weighed into a Kjedahl flask. 3tablets of sodium phosphate, speck of selenium catalyst and 25ml of concentrated H_2S0_4 acid were also added in the same flask. The solution was digested until it turns pale green colour, then cooled and washed into a 250ml graduated flask with distilled water up to the mark.

Micro kjedahl apparatus was used to determine the percentage nitrogen in the sample. A 100ml flask of boric acid was placed at the receiving end of the apparatus, then was allowed to come in contact with the sample which has been mixed with 5ml of NaOH. After about 2minutes of distillation, the boric acid was turned green. This is then titrated against concentrated Hcl acid. The result obtained in multiplied by a factor of 6.25 to given the percentage crude protein. This can be mathematically determined using.

$$\%\text{CD} = 0.00014 \times \text{Vol. of acid} \times \frac{250}{5} \times \frac{100}{w} \times \frac{6.25}{1}$$

CRUDE FIBER DETERMINATION

This was done using the trichloro acetic acid digestion reagent. The sample was put into a conical flask and the digestion reagent was added (100ml). this was boiled under reflux using a 3 feet long condenser for 40minutes. The solution was filtered and washed for about 6times with warm water. The residue was taken and weighed in the oven to dry for 24hours after which it was cooled and weighed. Then it was ashed at 600^{0}C to completion. It was cooled and reweighed.

$$\%\text{ crude fibre} = \frac{\text{Difference in weight}}{\text{Weight of sample}} \times \frac{100}{1}$$

ETHER EXTRACT

This was done on the soxhlet extractor with reflex condenser. A small flask which has been previously dried in the oven was fitted to the apparatus to collect the oil after extraction. The samples were wrapped and put in the extractor and petroleum ether was added to it, the apparatus was set to work and the extraction lasted about 6-7hours to ensure maximum expectation of oil samples

$$\%\text{ Ether extract} = \frac{\text{Weight of oil}}{\text{Weight of sample}} \times \frac{100}{1}$$

CARBOHYDRATE

The total percentage of carbohydrate content in the feed samples was determined by the difference method. This method involved adding the total values of crude protein, crude fiber, moisture ether extract and ash constituents of the sample and subtracting it from 100. The value obtained in the percentage carbohydrate constituent of the sample.

% carbohydrate = 100 (% moisture, +% crude fiber +% protein +% ether extract + % ash)

MOISTURE CONTENT

A known weight (2.0g) of the dried feed samples were put into crucibles (Washed, dried and weighed as w1) and weighed as W2. Therefore, the samples plus the crucibles were placed inside the oven and dried at 100^{0}C for 4hours, cooled and weighed at the same temperature for 30minutes until constant were obtained as W3. Then, the moisture content of the feed samples was calculated.

$$\text{Moisture (\%)} = \frac{(w2 - W3)}{W2 - w1)} \times \frac{100}{1}$$

PHYTOCHEMICALANALYSIS

Quantitative analysis for the determination of the phytochemical constituents of the feed samples were done according to Harborne (1973) as described in Ukpabi *et al.,* (2013).

ALKALOIDS CONTENTS

This was done by the alkaline precipitation gravimetric method. A known weight (5.0g) of the dried feed samples were weighed into a 250ml beakerand 200ml of 20% acetic acid in ethanol (1:10) was added and covered to stand for 4hours. This was filtered and the extract was concentrated using water-bath to one quarter of its original volume by evaporation and treated with drop-wise of conc. aqueous NH_4OH until alkaloids was precipitated. The whole solution was allowed to settle and the precipitate was collected by filtration which was later dried and weighed. The alkaloid content was calculated and expressed as mg/100g of the weight samples analyzed.

FLAVONOIDS CONTENT

A known weight (5.0g) of the dried feed samples were weighed into 100ml plastic bottle and expected repeatedly with 100ml of 80% aqueous ethanol at room temperature. It was filtered with whatman N0 42 filter paper into 100ml flask. The filtrated was transferred into a crucible dish and evaporated over a water bath. This was further dried in an oven at 60^{0}C for 30minutes and cooled in dessciator. The crucible and the content were weighed and recorded.

PHENOLIC CONTENT

A known fat – free samples were boiled with 50ml of ether for 15minutes. The extract (5ml) was pipetted water was added 2ml of ammonium hydroxide solution and 5ml of conc. amyl alcohol were also added. The samples were left to react for 3minutes for colour development. The absorbance of the solution was read using a spectrophotometer at 505nm wavelength. A blank sample for each extract was used for background subtraction. A standard phenol was prepared as 0.05mg/l and absorbance measured. The total phenolic content was expressed as mg/100g.

SAPONINS CONTENT

A known weight (5.0g) of the dried feed samples were dispersed into 200ml of 20% ethanol. The suspension was heated over a hot water bath for 4hours with continuous stirring of about 55^{0}C. The mixture was filtered and its residue re-extracted with another 200ml of 20% ethanol. The combined extracts were reduced to 40ml over a water bath at about 90^{0}C. The concentration was transferred into a 250ml separator funnel and 20ml of diethyl ether was added and shaken vigorously. The aqueous layer was recovered while the ether layer was discarded. The purification process was repeated after which n-butanol (60ml) was subsequently added and the combined n -butanol extracts were washed twice with 10ml of 5% aqueous sodium chloride. The

remaining solution was poured into a dried pre-weighed crucible and dried in an oven at 60^0C to a constant weight.

ANTIOXIDANT ANALYSIS

Determination of 2,2-diphenyl-pivylhydrazyl (DPPH)

Radical scavenging activity of the feed samples was measured by the method described by Mannan *et al.,* (2013) and Hsu *et al.,* 2007 with some modifications. 3ml of 0.1m DPPH solution was mixed with 2ml of extracts prepared at 0.04mg/ml and 0.08mg/ml. The mixture was shaken vigorously and incubated at room temperature for 30mins in the dark. The absorbance of the solution was measured at 517nm using a spectrophotometer. The percentage of DPPH radical scavenging activity was calculated using the formula.

DPPH radical scavenging activity (%)

$$= \frac{Ao - A1}{Ao} \times \frac{100}{1}$$

Ao in the absorbance of a DPPH blank solution

Ai in the absorbance of the test sample.

ANTI-NUTRITIONALANALYSIS

The anti-nutritional analysis of the feed samples were carried out in accordance with the method described in Ibrahim *et al.,* 2021.

DETERMINATION OF OXALATE BY TITRATION METHOD

This determination involves three major steps digestion, oxalate precipitation and permanganate titration.

Digestion: Sample powder (2g) was suspended in distilled water (190ml) contained in a 250 ml volumetric flask, 10ml of HCL was added and digested at 100^0C for 1hour, cooled, and then make up to 250ml mark with distilled water before filtration.

OXALATE PRECIPITATION

Duplicate portion (125ml) of the filtered sample digest was placed in two different 250cm^3 beaker, followed by the addition of conc. NH2OH solution (drop wise) until the test solution changes from its salmon pink colour to a faints yellow color. Each portion was heated to 90^0 cooled and filtered with Whatman N0. 1 filter paper to remove brownish precipitate containing ferrous ions. The golden yellow filtrate was heated to 90^0 and 5% calcium chloride solution (10 cm^3) was added while being stirred constantly. The solution was cooled and left overnight and there after, the solution was centrifuged at 2500rpm for 5mins. The supernatant was decanted and the precipitate completely dissolved in 20% v/v H_2S0_4 solution (20 cm^3).

PERMANGANATE TITRATION

The total filtrate resulting from the digestion and oxalate precipitation, was dissolved in 20% v/v H_2S0_4 solution (20cm^3) and was titrated against 0.05M $KMn0_4$ solution to a faint pink colour which persisted for 30secs. The calcium oxalate content was then calculated as

% Oxalate = (titre value x vme x DF)/ME x MF)

Vme = Volume of acid (titrants)

DF = Dilution factor

ME= Molarity of acid

MF = Mass sample

PHYTATE

Sample (2g) was soaked in 2% HCl (100 cm^3) for 3hours and then filtered through whatman N0. 1 filter paper. Filtrate (25 cm^3) was placed in a 100 cm^3 conical flask and 0.3% ammonium thiocyanate (5cm^3) was added as indicator. Then distilled water (53.5 cm^3) was added to the mixture to give it proper acidity, this was titrated with a standard Fe (III) chloride solution, which contains 0.00195g of iron per cm^3, until a brownish yellow color appeared

which persists for 5minutes.

CALCULATION

Phytic acids % = Titre value x 0.00195 x 1.19 x 100/weight of sample

GLYCOSIDIC CYANIDE

To 1g of the sample was macerated with 50mL of water. It was filtered with whatman N0 1. Filter paper. One milliliter (1mL) of the filtrate was pipette in to a test tube and 4mL of alkaline picrate solution added to it. The solution was boiled for 5mins. It was then cooled in a water bath. The absorbance of solution was read at 490nm.

Cyanide (mg/100g)

$$= \frac{\text{Absorbance of sample x Dilution factor}}{\text{Water of sample}}$$

TANNINS

Tannin content was determined by the photometric method. The samples (5g) were weighed into 100ml plastic bottle. 50ml of distilled water was added and shaken for 1hr in a mechanical shaker. This was filtered into a 50ml volumetric flask and made up to the mark with distilled water. Then 5ml of the filtrate was pipetted out into a tube and mixed with 3ml of 0.1m $Fecl_3$ in 0.1N HCL and 0.008M potassium ferrocyanide. The absorbance was measured in a spectrophotometer at 260nm wavelength within 10minutes. A blank sample was prepared using the extraction solution (distilled water). A standard solution of tannin acid (5mg /ml) was prepared and with the blank reagent at zero the standard absorbance was measured at 760nm wavelength.

HEAVY METALANALYSIS

Atomic absorption spectrophotometric (AAS) method as described in Ukpabi *et al*(2013) was used in determination of heavy metals. Each of the sample (2g) was weighed into the beaker and digested with 20ml of conc. HNO_3 and 10ml of conc. HCLO4 on a hot plate with gentle boiling. The digested samples were evaporated to dryness and the residue mixed with 10ml of 2.0M HCL filtered into a 100ml standard flask using whatman N01filter paper. Several digested samples were analyzed for the heavy metals of interest Fe, Zn, Pb, Cr, using in atomic adsorption spectrophotometer (UNICAM 969 Japan). The effectiveness of the methods used was tested by using spiked samples that were later used as reference samples.

RESULT AND DISCUSSION

An assessment of nutrients composition of some locally blended feeds is paramount for feed formulation (Café *et al.,* 2012). Nutrient analysis gives information on the basic nutrients in feed samples. The birds are reared mainly for meat and egg production and of all the different types of poultry, chicken in the most predominant and of this class is the broiler. They require the various classes of nutrients viz carbohydrates, proteins, fats, minerals, vitamins and water. Inadequate supply of these nutrients will manifest in disease symptoms which only be corrected by providing the lacking nutrients (Obizoba *et al.,* 2014). The result of the nutrient composition of the feed samples in shown in table 1

Table 1: The nutrient composition of the locally blended feeds used in this study

Proximate/Nutrient	LBF1	LBF2	LBF3
Moisture	4.52± 0.40	3.68±0.90	2.12+0.30
Dry matter	95.48±1.73	96.32±1.96	97.88±2.00
Crude fiber	7.01±0.88	7.51±1.08	8.20±0.79
Ash content	5.20±0.58	5.72±0.75	6.05±0.48
Ether extract	4.75±0.69	4.95±0.63	5.91±0.84
Crude protein	17.85±1.26	16.54±1.87	15.10±1.30
Carbohydrate	64.67±0.87	66.28±1.86	67.17±1.92

The moisture contents of the samples were within the range of 2.12± 0.30 and 4.82±. 0.40 The moisture contents of the samples were within the recommended value (5.43%) for animal feeds as stipulated by USDA (2005).The moisture content of feeds is an indicator of its durability as low levels revamp the increased microbial activity.

Dry matter content of feeds, gives the platform for the comparison of feeds nutritional potentials.

Dry matter content of LBF3 feed is higher (though not significant) compared to other feeds. This result indicates that LBF3 had higher nutrient biomass than others. Proteins sources are the most expensive ingredients in livestock rations including that of broilers and they primarily supply amino acids required for normal functioning of the body system.

Crude protein content in an indicator of the nutritional quality of feed ingredients.

The crude protein contents of the feeds ranged from 15.10 ±1.30 to 07.83±1.26 which are below the minimum standard range of 19-20% (Alum *et al.,* 2020) of broiler birds. Therefore, these feeds must be supplemented with good protein feed ingredients so as to satisfy birds, nutrient requirements.

Fiber is an essential component of carbohydrate and it is generally regards as the fractions that are not readily digestible. The crude fiber values of the samples ranged from 8.20 to 75 (LBF3) to 7.01±0.88

High fiber components in feeds aids digestion and thereby improves the animal health

Dietary fats have been reported to improve palatability of feeds by absorbing and retaining flavours (Yusuf *et al.,* 2022). The ether extract of the samples ranged from 4.75±0.09 (LBF1) to 5.91±0.84 (LBF3) the implication of the low values of the feeds in the study in that they are low in energy concentrates. Besides supplementation bioavailability is an important fact affecting growth performance of birds.

Table 2: The Anti-nutrient composition of the locally blended feeds used in this study

Anti-Nutrient	LBF1	LBF2	LBF3
Tannins	0.120+0.02	0.129±0.03	0.139±0.02
Glycoside cyanide	0.050±0.02	0.038±0.02	0.047±0.01
Oxalate	1.350±0.20	1.329±0.18	1.285±0.08
Phytic acid	0.050±0.02	0.080±0.02	0.120±0.032

Cyanide occurs mainly in the form of cyanogemic glycoside. These glycosides enzymatically hydrolyzed to hydrocyanic acid which usually cause reduce growth, poor feed efficiency and death when consumed in high amounts.

Phytic acid depresses the utilization of several mineral elements such as Ca, Mg, Fe, Zn, etc by forming insoluble compounds which are eliminated in the faces. Oxalic acid binds with nutrients rendering them inaccessible to the body. This chemical combination results in the formation of oxalate salt. Oxalates reacts with calcium to produce insoluble calcium oxalate complex reducing calcium absorption in the gut (Ramteke *et al.,* 2019).

Tannins cause dry sensation in the month, probably by reducing the lubricant action of glycoproteins in the saliva. They bind the proteins and are thus inhibitors of proteolytic enzymes. Its high contain also depresses cellulose activity and thus affects, digestion of carbohydrates. The experimental results obtained from the analysis of the feed samples, for heavy metals examined showed the presence of zinc and iron at concentrations below the permissible limits as stipulated by the European union (Alum *et al.,* 2012). Meanwhile chromium and lead were not detected in the feed samples examined.

Table 3: Heavy metal composition of the locally blended feeds used in this study

Heavy metal	LBF1	LBF2	LBF3
Chromium	0.000±0.00 BDL	0.000±0.00 BDL	0.000±0.00 BDL
Lead	<0.01 BDL	<0.01 BDL	BDL
Zinc	1.540±0.17	0.633±0.07	0.940±0.48
Iron	10.014±1.52	11.180±1.30	9.710±1.40

BDL = Below detection level

Adverse health effect as a result of heavy metal toxicity has also received attention, especially metals that are toxic even at low concentrations.

Xenobiotic metabolic processes produce reactive oxygen species (ROS) which result in the damage of cells. Organisms scavenge and dispose of these ROS by use of antioxidant and defense systems present in several subscellular compartments. When there defense fail to halt the self- propagating auto-oxidation reactions associated with ROS cell inflammation/death ultimately results. The major antioxidant species in plants are ascrobate, reduced glutathione, x-tocophenol and carotenoids. Polyamines and flavonoids also may provide some protection from free radical injury.

DPPH assay is considered the most significant test to evaluate the free radical absorbing capacity of plant extracts. The DPPH radical scavenging potential of plant extracts results mainly from their hydrogen donating tendency. This assay provides information about the reactivity of organic compounds with free radicals. The feed sample extract decreased the concentration of DPPH radical in dose –dependent manner as shown in table 4.

Table 4: Anti-Oxidant composition of the locally blended feeds used in this study

DPPH	LBF1	LBF2	LBF3
0.04mg/ml	3.61±2.01	30.79±2.71	27.16±2.36
0.08mg/ml	4.25±1.23	39.10±0.12	35.63±0.56

Recently, cereal and legume crops and food-derived antioxidants such as flavonoids have received growing attention, because they are known to function as chemprevention agents against oxidative damage. These phytonutrients have been widely used in livestock production with proven bioactivities such as anti-microbial, immune enhancement and stress reduction properties ( ).

These phytonutrients have not only been proposed as replacement for antibiotics and growth promoter but also used as dietary supplementation. The results of phytochemical analysis revealed low concentrations, of the phytochemicals detected as shown in table 5.

Table 5: Phytochemical composition of the locally blended feeds used in this study

Phytochemical	LBF1	LBF2	LBF3
Alkaloids	0.26±0.10	0.25±0.11	0.17±0.10
Flavonoids	0.38±0.11	0.33±0.12	0.28±0.10
Saponins	BDL	BDL	BDL
Phenols	BDL	BDL	BDL

BDL = Below Detection Level

CONCLUSION

Based on the result obtained, the feeds has crude protein values lower then their required percentages for proper growth performance. Therefore, these feeds must be supplemented with good protein feed ingredients and so as to satisfy, broilers, nutrient requirement. The anti-nutrient and heavy metal values were within the permissible limits to avoid poor bioavailability of nutrients and heavy metal toxicity respectively.

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CIVIC EDUCATION, CITIZENSHIP AND NATIONAL SECURITY

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ABSTRACT

This study concentrates focus on the explication of the linkages between civic education and national security. It therefore pays close attention at the quality of civic education on the citizens and the importance of civic education in national security. A detailed consideration is given to the question of civic education as a key factor to achieving knowledgeable, educated and civilized citizens that would accumulatively culminate to national security. The study establishes two theoretical frameworks: cognitive development and participatory communication theories to situate and provide the needed compass that guides the research direction. This is followed by findings linking civic education to the achievement of national security. The study concludes with some recommendations which include: civic education should be made a mandatory course and subject from the basic to the tertiary levels of education in Nigeria irrespective of the discipline that one leans. Again, informal education models such as mass media should be effectively deployed to impact civic education on the citizens. Moreso, adoption and utilization of the local languages or dialects could make civic education impartation seamless.

Keywords: Civic Education, Citizenship, National Security.

INTRODUCTION

Nigeria in recent time has been confronted and challenged with avalanche of social ills and vices which pose grave danger to the national security. Some of the challenges range from environment, religion, social, political and economic. The environmental degradation, attendant floods and ecological menaces, religious bigotry and intolerance that result in sectarian crises, insurgency, banditry, killer herdsmen, political and/or electoral violence, cybercrimes, armed robbery, human sacrifice, corruption, bad leadership and governance etc are eloquent testifiers that the national security of Nigeria is facing serious threats. Available records show that security takes more allocation from the budget in recent times than other sectors of economy, yet, security improvement is very insignificant. Galadima (2017).

For two decades now, there has seen a dimension of insecurity that has to do with religious coloration that proscribes education and labels it sin (Boko Haram). To them, western education and civilization are at variant with their religion and that adherents should forbid education. The same sect encourages the practice of *almajiri* system that allows for religious indoctrination and slavery disposition (Audu 2012). This has impacted on civic education especially in northern Nigeria. It has also shore up on the quality of citizenry in terms of been loyal to the Nigerian state or to their religion.

Moreso, Nigeria is a signatory to the United Nations chatter on education. The chatter has proposed the bench mark of 26% of its member state's annual budget to education. According to Sinwa (2022), the international body has identified education is the major key that unlocks and sponsors any sustainable development. Between 2015 and 2022, Nigeria allocates between 6% - 9% of each annual budget to education which experts believe cannot stimulate and drive the desired quality of education the nation has yearned for. This explains why many Nigerian elite prefer sponsoring their wards abroad.

This paper is focusing principally on how to reverse the rather negative realities through civic education of the citizenry for the attainment of national security such that peace, justice, progress, unity and peace which are invaluable tangible assets reign supreme.

STATEMENT OF THE PROBLEM

It is highly perceived and strongly believed that the greater percentage of social ills and vices are caused by the Nigerian citizens who are educationally backward. Some social pontiffs advance that there is a lack of civic education across some social classes and segments of the Nigerian population especially the children of school age to the youth up to 50 years. These classes of the citizens have been rendered bankrupt in terms of knowledge, information and enlightenment that would have helped arm them socially, politically and economically to rightly become intellectually independent for the proper definition of their purpose and responsibilities as good citizens. Consequently, they have become the breeding agents and vectors of vices that have stoutly challenged the national security of Nigeria. (I)

Secondly, the Nigeria's image and reputation outlook has been all time low, located and sighted at the bottom of the international perception index. According to Enahoro (2002), Nigeria only majors in minors and minors in majors. What this means is that Nigeria tops the list of countries with poverty, corruption, misery, unemployment, disease, terrorism and anything negative (minors) and rather comes last or counted among the last countries in terms of sound health, security, rule of law, democracy and good governance. Again, thinkers believe that those who are privileged to lead Nigeria are not effectively, efficiently and adequately embracecivic education and that there are still some ingrains of their world views (religious, regional, and ethnicity) which still be cloud their sense of leadership. This, according to them is the major reason Nigeria as a country is yet to records significant growth and achievements after independence. The question therefore is; how do we bring everyone on the same page to properly advance the course of national security in Nigeria? Can the civic education clean up the mess and menaces that Nigeria is bedeviled and then redefine, redirect and chart the new course of action for national advancement? (ii) (I)

OBJECTIVES OF THE STUDY

The overall objective of the study is to locate and

connect the nexus among civic education, citizenship and the national security. Other objectives include but not limited to:

To unveil the menaces, ills and vices that have threatened the national security and the corporate existence of Nigeria as one indivisible nation under God as envisaged and enshrined in the Constitution of the Federal Republic of Nigeria 1999 as amended.

To help review the scope of the civic education in Nigeria. Particularly, civic education curriculum developers could draw from the study more areas that need to be explored for the attainment of the extension of the frontiers of knowledge in this regard.

(iii) The study will surely help reverse the vices that threaten the Nigeria's national security. It will equip and reposition the Nigerian citizens to defend Nigeria with all their strengths, uphold her honour and glory.

RESEARCH QUESTIONS

The following are questions set for the study:

What are various vices that threaten the Nigeria's national security and its corporate existence as indivisible nation under God?

(ii) Can civic education be the toga that will reengineer the Nigeria's citizens to achieve national security?

(iii) Is the current curriculum for civic education adequate to answer the national security questions and meet the set objectives of attainment of civic values that would guarantee peace, love, unity and progress which are the key indicators of the national security?

(iv) What should be done to halt or stem the tides of insecurity in Nigeria?

THEORETICAL FRAMEWORK

In order to situate the study, Cognitive Development Theory was deployed as the theoretical framework. The Cognitive Development Theory was postulated and developed by a Swiss Psychologist Jean Piaget. The theory deals with "the processes by which human beings acquire and use knowledge to solve problems" (Shaffer and Kipp 2007, p. 243). The theory explains that knowledge and acquisition of it results in intelligence which is the basic life function that enables individuals to make decisions that are consistent with their needs and preferences as well as react knowledgeably to certain stimuli and adapt to their environments.

LITERATURE REVIEW

Civic Education

Civic education has a wide range of definitions depending on the prisms through which various countries view it. Civil Education has two components: civics and education. Etymologically, the word "civics is a derived from Latin word "civicus" meaning relating to citizen. The term relates to behaviour affecting other citizens particularly in context of urban development Simwa (2022). Citizens are therefore expected to culture and develop a kindly acceptable behaviour that will help shore up symbiotic benefits between and among the state and citizens. They are to portray desired character traits and act in a responsible manner for the development of the community and nation at large. Similarly, the word education is equally derived from Latin word *educere, educare,* and*educatum* which means "to learn", "to know" and "to lead out". That is education means to lead out internal hidden talent of a child or person. Education is the act or process of imparting or acquiring general knowledge, developing the power reasoning, judgement and generally of preparing overly or other intellectually for mature life. It is the act or process of imparting or acquiring particular knowledge or skills, as for a profession. https//www.dictionary.com

Biblically and scripturally, education is "to train or instruct the child in ways that they can never forget as they grow". However, this does not include the indoctrination of a child in the wrong way. It specially and apparently implies that all instructions must be disciplinary, that is by directing the child in the right direction to do the right thing. See Proverbs. 22:6.

By bringing the two concepts together therefore, civic education means all the processes that affect people's beliefs, commitments, capabilities, and actions as members or prospective members of communities.

According to Sinwa (2022), civic education is a public, socially-oriented system of continuous education and upbringing aimed at building civic competence, democratic culture and satisfying the needs for socialization in the interest of the individual, civil society and the rule of law.

Accordingly, civic education can be defined as the provision of information and learning experiences to equip and empower citizens to participate in democratic process. For Hark Voort and Olsson (2014), civic education is referred to as "democratic mission" and it includes fundamental values, like inculcating "respect for human rights and the fundamental democratic value on which society is based".

Civic education has further been argued to be a suitable place for practicing persuasive and argumentative writing, where articulation of ideas, analytical skills, use of concepts, structure and systemization are achieved(Brett (2014). Dewey has opined that civic education is the study of the institution, practices and behavioursthat support democratic life and the systematic effort to prepare young people to undertake their role as citizens.

In furthering the concept of civic education, Dewey thought of school as "embryo communities" institutions in which the child (and even adult) is, for the time, socialized to be a member of a community life in which he feels that he participates, and to which he contributes to further the wellbeing of the community. The core values of education may be learning to talk and listen with other people about public problems. That is a cognitively and ethically demanding activity that can be learned from experience. The core, semi-core and the peripheral values of the community or nation is properly inculcated in the members through formal and informal agents of socialization.

(d)

(e)

Experts have identified the goals of civic education to include: formation of civic qualities on the basis of new knowledge, formation and acquisition of skills and values that help to solve emerging problems, help individual to adapt socio-economic and political condition/environment, represent and /or protect the rights and interests of human, community and nation etc. The goals identified could be achieved through human right education, teaching a culture of peace, education of tolerance, development of intersectoral social partnership.

Target of Civic Education

Civic education is targeted at a wide spectrum of the society. The elasticity of the scope includes but not limited to:

(a) School children and students who are formally socialized into the value, beliefs, tradition and culture of the nation. This group of people spans from nursery, primary secondary and tertiary levels of education.

(b) Teachers who are themselves custodians of the curriculum and who instill the knowledge and inculcate same on the school children and students across all levels of learning.

© Military and security forces who are saddled with the responsibility of maintaining peace and the protection of lives and property and whose conducts and role of engagement must be within legal framework, rule of engagement and moral

altruistic and civic disposition.

State employees who are civic and public servants that execute policies and programmes of government and who are expected to carry out their duties with “highest degree” of loyalty, honesty and integrity.

Non-Government Organizations who are the vanguards and champions of human rights and justice and whose social crusades are a desired ingredient of good governance and democracy.

(v) Prisoner and other risk group. Prisoners are those who are convicted and are serving sentences in various prison or correctional centres (as branded in Nigeria). Other risk groups include ex-prisoners, indoctrinated and religious bigots and extremists, repented terrorists, destitute, Internally Displaced Persons (IDPs), orphanage homes etc. These groups are targets of civic education to reset and re-oriented their mindsets so as to harvest their potentials for the advancement of peace, democratic values and production ventures.

(vi) Pensioners and older people who are at the verge of transferring batons of values to the younger generations and who are in a rather difficult and challenging stage of life.

(vii) The general public who are expected to play their role of civic obligations and duties such as payment of tax, voting at the elections, volunteering information for security agencies and obedience to the rule of law. Therefore, civic education targets at everyone and all classes of the society for the maintenance of same nation.

CITIZENSHIP

Citizenship is the position or status of being a citizen of a particular country. To situate it properly, it is important to understand that a citizen is a legally recognized subject or national of a state either native or naturalized. A citizen is considered an inhabitant of a particular town or city.

Generally, citizenship is a relationship between an individual and a state to which the individual owes allegiance and in turn is entitled to its protection. Citizenship is the expression of a public identity, a recognition of an official position by a government and the ability to enjoy the rights and privileges flowing from that position by an individual.

Experts have scholarly viewed the concept of citizenship in three main elements or dimensions (Cohen 1999): The first dimension of citizenship is legal status as defined by civic, political and social rights. Here, the citizen is viewed as the legal person free to act according to the law and having the right to claim the law's protection.

Second, citizenship is focused from the prism of political agency, actively participating in political mobilization and process and building political institution. This means the citizen has the sense of political inclusiveness both in theory and practice.

Thirdly and lastly, citizenship is viewed from the standpoint of membership in a political community that furnishes a distinct source of identity. What this means is that a citizen is a citizen whether from the legal or political angles in as much as he can properly identify himself as a member of a geo-political entity.

The distinctive relationship among the three dimensioned identified is largely because “the rights a citizen enjoys will partly define the range of available political activities while explaining how citizenship can be a source of identity by strengthening her sense of self-respect” (Rawls 1999, p.544). Again, a strong civic identify can itself motivate citizens to participate actively in their society's political life (Carens 1987).

The republicans: Aristotle, Tacitus, Cicero, Machiavelli, Harrington and Rousseau (etc) in their various writings and thoughts argued that citizenship should be predicated and explained from the political participation and inclusiveness where citizens are

absolutely free to hold political office and allowed for self-rule. In the whole, the republican model emphasizes citizenship not based on legal or social status but strictly on political agency (Kymlicka 2000).

On the other hand, the liberal models of citizenship origins are traceable to the Holy Roman Empire and early modern reflections on Roman law (Walzer 1989). The empire's quest for expansion resulted significantly in citizenship rights being extended to conquered peoples. Thus, citizenship meant being protected by the law rather than participating in both the formulation and execution of law. Therefore, legal status of citizenship was highly emphasized (ibid). The primary focus here is obviously the first dimension that citizenship is essentially understood as a legal status rather than the second or third dimension which talk about political participation consideration and social rights respectively. The liberal perspective of citizenship has clearly shown that “membership in a community is weaved with threads of shared and common law, which may or may not be identical with a territorial community” (Pocock 1995, p. 37).

Thinkers argue that a cursory look at the two models of citizenship as posited by the belligerent of the republicans and liberals shows that both goes hand in hand and one is complementary to another. For instance, political liberty as constant quoted by Fontana (1988) is necessary in the guarantee of individual liberty. This thought are also shared and echoed by Walzer and Ackermann. Citizen can be acquired by family (*jussanguinis*), by birth (*jussoli*) by marriage (*jusmatrimonii*), by naturalization and by investment or economic or corporate citizen. In Nigeria, there are only three ways to acquire citizenship: By birth, registration and naturalization. Section 25 of the Nigerian constitution has given details on the eligibility of Nigeria citizenship particularly by birth to include those born in the territory of Nigeria after 1st October 1960 that have a least a parent or grandparent who belong or belonged to a community indigenous to the geographical location called Nigeria.

Also, individuals born outside of Nigeria whose parents or grandparents were or are citizens of Nigeria are said to be citizens. This is citizenship by birth via decadency. Section26 (1) of the constitution deals with citizenship by registration under three conditions: A person of good character disposition that must be attested to by at least two reputable persons, the person who shows a clear and strong desire to be a resident in Nigeria by fulfilling residency requirement and thirdly a person who takes objects, an oath of allegiance to Nigeria provided in schedule of the Nigerian constitution. Section 26 (2) allows for citizenship by registration particularly for a woman who is married to a man from Nigeria and those adults whose grandparents are from Nigeria and wish to register as citizens of Nigeria.

Lastly, we have citizenship by naturalization and which is captured by section 27 of the constitution, provided certain requirements subject to section 28 of the same constitution are made, this category of able if persons can apply to the resident of the Federal Republic of Nigeria. The persons must live for a period of 15 years in Nigeria, be of a good conduct, had been administered the oath of allegiance, capable of contributing to the wellbeing of Nigeria and its citizens and is accepted by the host community and state they wish to reside.

National Security

The concept of security is a primary concern for the survival of humans and nations. Environment security, human angle security: food, shelter, water, education, job etc and of course physical security are all geared to preserve and protect humanity from harms (James 2021).

Security is defined as protection from or residence

against potential harm or other unwanted coercive change caused by others, by restraining the freedom of others to act (Roger 2010). Security has a wider scope of coverage such as freedom from want, food security, residence against potential damage or harm, keeping of secrets, (eg cyber security) containment or emotional security. The term "security" is derived from the verb "secure", the lexicon that entered the English language in the 16 century and which is derived from two Latin words ***se*** (without) and ***cura*** (care, anxiety). Therefore, security means freedom from anxiety (Barry, B; etal). Security is extremely desired and beneficial to persons, social groups, nations, community, institutions, ecosystems, entity or phenomenon vulnerable to unwanted change.

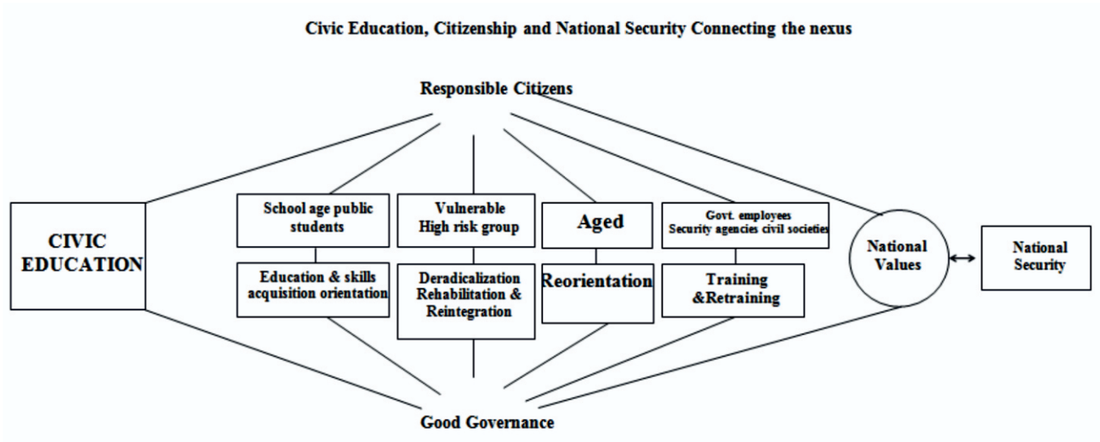
National security is basically seen from two prisms: The realist school of thought and the idealist school of thought. Frontline among the realists is Walter Lipmann who sees national security from physical security. According to him, "a nation should be secured to theextent to which it does not have to sacrifice its legitimate interest to avoid war and is challenged to maintain them by war". According to Michael Louw, a state must be free from external all moral and their intellectual dangers should be considered, but it is physical violence that is widely regarded as the ultimate leverage against the state, and thus has a real and tangible threat to its survival. Orvik puts it thus "security would be a matter of course if there were no threats to national ideals and institutions". All realists corroborate that national security is basically external threats and must be removed for the state to survive. To do this, much emphases and premium are placed on military capabilities and capacity to strengthen the military might. Therefore, the state should build military industrial complexes for the production of both conventional and strategic weapons to detect, detain, deter and destroy potential external threats to the state. But the state is more than just the territory; state document, population, property and critical national infrastructure could be under serious internal threats. Also the fact that the nuclear age has brought nations on the table of balance of terror and deterrence capabilities as well as mutual assured destruction, foreign policy and diplomatic methods have significantly changed from exploring military options to tackle national security.

They also opine that deterrence may fail because the deterrent could be empty or the threatened state can muster courage to resist threats. For instance, during the cold war between the United States of America and Vietnam, the US lost to Vietnam despite the fact that the military capacity between the duo is 1000:1. Presently, Russia saw Ukraine as a nation to be wiped by a single stroke of missile but Ukraine has resisted Russia and sustained the war since 14 February, 2022 till this moment. Security and defense experts have predicted that Russia may not win the war after all. This therefore takes us to the idealists school of thought on national security. While the realists pay more attention on external force, the idealist however argue that threating external force deal with national security is not sufficient. According to Morton Berkowits and Bookes, definition of national security as "a nation's ability to preserve its internal values from external dangers is still inadequate. It implies that dangers to a country's security originate from the outside, but it ignores the threat from within". He argues that political unrest and widening economic unbalance and/or inequalities, regional development disparities as well as cultural, linguistic and ethnic animosity etc are the bane of modern politics. To larger or lesser extent, every nation must protect itself from them. To idealists, when a nation is economically and technologically developed, politically secured and socio-culturally unified, it can be said to have a sword for its own protection (Singh 2015). Similarly, Subrahmanyam, an expert on security and defence studies in India clarifies that "national security does not simply imply preserving territorial integrity. It does also entail ensuring the country's industrialization and the development of a unified, equitable and technical society. Anything that gets in the way of its progress, whether inside or outside, is a national security threat (ibid).Subrahmanyam's view is basically from the standpoint of third world on national security. The study therefore, combines both realists and idealists' schools of thought to really have a balanced definition of national security. Hence, national security is the nation's ability to protect itself from, and resilience against potential harm and other unwanted coercive change caused by others within or without.

Civic Education, Citizenship and National Security: (I)

Connecting the Nexus

There is a strong cord that links civic education, citizenship and national development. As shown below, civic education whether formal or informal criss-cross all population: school age, pupils, students, vulnerable and high risk groups such as prisoners, *almajiris*, prostitutes and destitute. It also includes the aged, government employees, law makers, security agencies and civic societies etc.



For the school age, pupils and students at all levels, civic education is geared to educating them to acquire skills on good government and socializing them into democratic ideals and process with the sole aim of moulding them to become responsible citizens. Similarly, the vulnerable groups are de-indoctrinated from religious extremism and bigotry. They are deradicalized, rehabilitated and re-integrated into the society through civic education. The aged population is also given a new orientation as they move into another critical stage of life with attendant experience associated with old age which must be properly managed to still maintain them as responsible citizens.

Moreso, government employees, law makers, civil societies and security agencies are given civic education to bring about loyalty. All this put together will bring about national value that will ultimately result in national security.

CONCLUSION

The study looked at the connecting thread that weaves through civic education and citizenship to bring about national security. Based on the findings, it therefore concludes that civic education can actually promote and preserve responsible citizens,

national value and national security.

RECOMMENDATIONS

The following recommendations are suggested:

Civic education should be taught and made mandatory at all levels of education in Nigeria. This will surely shrink the level of ignorance among citizenry and promote education and good governance.

(ii) Civic education curriculum should be reviewed in view of the realities such as cybercrimes, terrorism, banditry, kidnapping, separatism to create awareness and enhance citizenship education.

(iii) More legislation should be enacted to bring about good governance that will be attractive for the larger population to participate in democratic process and fulfill their civic duties and responsibilities.

(iv) Nigeria should establish and build strong institutions to deal with national insecurity.

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COMPARATIVE STUDY OF DESIGN CHECKS FOR A GIVEN UNIVERSAL STEEL BEAM SECTION USING EUROCODE 3 AND BS 5950

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ABSTRACT

Asteel beam is a structural element that basically opposes loads applied along the beam's axis. Although the steel design standard, EN 1993-1-1 had successfully drafted into Malaysian National Annexes MS EN 1993-1-1 at 2010, survey conducted by BEM since mid-2014 shows that many Engineers have given negative responses on their awareness and confidence level in the use and adoption of structural Eurocodes in place of British Standards. The main objectives of this paper is to show the comparative study of design checks for a given universal steel beam using British Standard (BS 5950-1-1:2000 "Code of Practice for Design-Rolled and Welded section") and Eurocode (MS EN 1993-1-1:2010 "General rules and rules for buildings"), hence, how load factors between the two codes influences deflection, buckling, economy and workability. To achieve this aim, a three phase study concept was adopted, Phase 1(Deck Study), Phase 2(Design Analysis), Phase 3(Result Comparison), and a simply supported universal steel beam was subjected to the following loads/actions and length: Permanent load (Gk)-18.4KN/m, Variable load (Qk)-12KN/m, length-8m. It was found that the Eurocode 3 is able to reduce the requirement of the beam shear capacity by 4.06%, reduce moment capacity by 6.43%, and deflection value due to non-factored imposed load by3.63%. The results are useful for Engineers to become aware that Eurocode 3 is more economical for design of plastic class 1universal steel beam sections which are fully effective under pure compression.

***Keywords*:** Universal Steel Beam, British Standards, Eurocodes, Deflection.

INTRODUCTION

Steel is considerd to be one of the most common materials used in construction industry, the reason is that it has many benefits some of which are; adaptability, beauty, cost-effectively, durability and ductility. A steel standard code is required to serve as a reference document with important guidance. Hence, in this dissertation, British Standards and Eurocodes are used.

As used in this dissertation, British Standard is BS 5950 -1: 2000, "Structural Use of Steelwork in Building. " It is a standard that combines codes of practice which covers the design, construction and fire protection of steel structures and specifications for materials, workmanship and erection. BS 5950 - 1: 2000 is the structural code used to supersede BS 5950 - 1:1990, "Structural Use of Steelwork in Building" and is widely used in Malaysia. The standard consists of nine parts and Part 1 of the standard, BS 5950-1-1: 2000 "Code of Practice for Design – Rolled and Welded sections" is used in this research work.

The Eurocode 3 is a set of European Standards produced by the European Committee for Standardization of the steel design. Eurocode 3 consists of 6 parts and part 1, EN 1993 - 1: 2005, "Design of Steel Structures" which gives the basic rules for design of buildings in steel is used. EN 1993 - 1: 2005 is largely similar in scope to BS 5950 – 1: 2000 which was replaced by about 2010. It consists of twelve subparts and Part 1.1: General rules and rules for buildings (EN 1993-1-1) is used in this dissertation.

Since March, 2010, the British Standards had been withdrawn and replaced with implementation of Eurocodes in the United Kingdom (UK) including British Standard 5950, the design code for the structural use of steel to Eurocode 3 (Eng, 2010). The Institution of Engineers Malaysia (IEM) have taken initiative that have led to the replacement of the existing British Standard being the main source of structural design code in Malaysia since 2002. Thus, this initiative is of utmost importance as it has replaced the current applied British Standards to new Eurocodes as the British Standard will no longer be revised.

By 2010, five of the Eurocode parts had been drafted into Malaysian National Annexes that relates structure design in concrete and steel design i.e. ME EN 1990, ME EN 1991-1-1, MS EN 1992-1-1 and MS EN 1993-1-1 and MS EN 1997-1-1.

PROBLEM FACE BY DESIGN CHECKS FOR A GIVEN UNIVERSAL STEEL BEAM SECTION USING EUROCODE 3 AND BS 5950

The steel design standard, EN 1993-1-1 had successfully been drafted into Malaysian National Annexes MS EN 1993-1-1 at 2010, the survey conducted by BEM since mid-2014 showed that a greater number of engineers gave negative responses to the questions posed on their awareness and confidence level in the use and adaption of structural Eurocodes as an alternative to British Standards. The results indicated that more than half of the respondents were unwilling tosubmit their design based on Eurocodes. The problem faced by practicing engineers in the adoption of Eurocodes were lack of initiative in learning a new design standard. The reason for this was that the learning of new designs was a tedious and time-consuming process.

MATERIALS AND METHODS

The study took into consideration the design checks for a given universal steel beam section using BS 5950 and Eurocode 3 comparison of a simply supported I - beam section. The design involved the selection of appropriate section that satisfied the limit state of requirements. Basically, this study was carried out in three phases in order to understand the concept of design based on Eurocode 3 and compare the design concept with BS 5950.

RESEARCH DESIGN ANALYSIS OF BS 5950 AND EUROCODE 3

It is desired to select an appropriate selection to satisfy the ultimate and serviceability limit state requirement for a uniformly distributed simply supported universal steel beam that is subjected to the following loads/actions and length. Permanent load (G_k) = 18.4 KN/m, Variable load (Q_k) = 12 KN/m, and Length of the beam = 8m.

TYPICAL LOOR PLAN STEEL BEAM LAYOUT

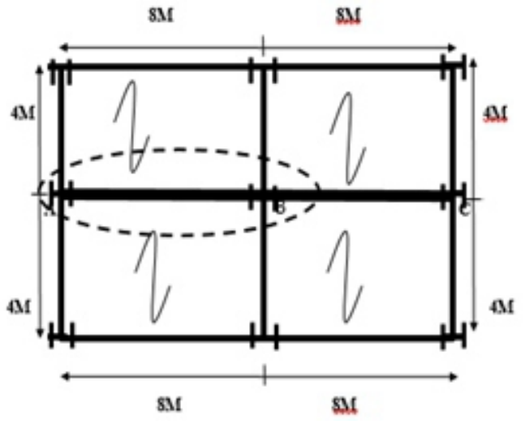


Fig. 1. Typical Loor Plan Steel Beam Layout

SLAB; $L_y/L_x = 8/4 = 2$

One Way Slab.

Design beam A & B using BS 5950 and Eurocode 3

Imposed load: Type of activity/ occupancy for part of the building (category C area with tables).

Specific use: Class rooms. Note, Imposed load from BS 6399.

Dead load: Weight of concrete slab = 24KN/m^3,

Depth of slab = 0.150M (i.e. thickness of floor panel),

Finishes = 10KN/m^2.

Load Calculation:

Impose load (Q_k) = 3.0 KN/m^2 (from BS 6399)

3.0 KN/m^2 x 4 m = 12KN/m.

Dead load (G_k);24KN/m^3 x 0.15 m x 4m = 14.4KN/m.

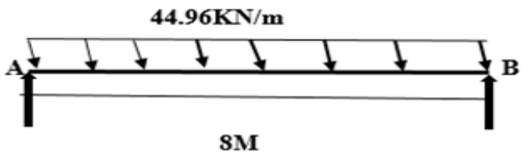
Finishes; 1.0KN/m^2 x 4m = 4KN/m.

Total dead load; 14.4 KN/m + 4KN/m = 18.4KN/m.

BS 5950 BEAM DESIGN:

Ultimate Load:

$1.4(G_k) + 1.6(Q_k)$; 1.4(18.4) + 1.6(12) = 44.96KN/m



H = 0, H_A = 0, V = 0

$V_A + V_B$ = 44.96KN/m x 8m = 359.68.

SECTION



MOMENTS CALCULATION

Moment about A;

M_A = 0

44.96 x 8 (8/2) - V_B (8) = 0

$8V_B$ = 44.96 x 8 (8/2) = 0

V_B = 1438.7/8 = 179.8

Moment about B;

$V_A(8)$ - 44.96 x 8 (8/2)

$8V_A$ = 1438.7/8 = 179.8

∴ $V_A + V_B$ 179.8 + 179.8 = 359.68

V_I = 0

179.8 - 44.96(X) - V_I

At, X = 0, V_I = 179.8

At, X = 2, V_I = 89.88

At X = 4, V_I = - 0. 04

M_I = 0

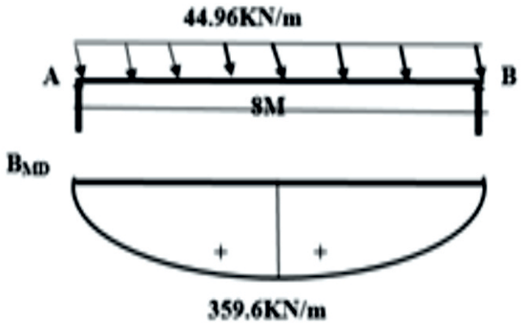
179.8(X) - 44.96(X)(X/2) - M_I = 0

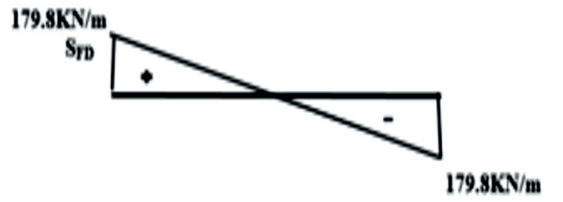
179.8(X) - 44.96(X)^2 = M_I

At, X = 0, M_I = 0

At, X = 2, M_I = 269.68

At X = 4, M_I = 359.6





INITIAL SELECTION OF SECTION

Moment Capacity of section; $M_C = PS_y$, Where; S = Plastic modulus of section, P = Yield Strength of steel.

$S = M_C/P_y$ = 359.6KN/m / 275 N/mm^2

= 359.6 x 10^{6}Nmm / 275Nmm = 130736.364mm^3 / 1000 =1307.63cm^3

S = 1307.63cm^3

From universal beam properties table BS 1993:

S_P= 1346cm^3, Beam section = 406x178x67, I_{XX} = 24330cm^4, Z_{xx} = 1189cm^3, M = 67.1kg/m, D = 409.4mm, B = 178.8mm, t_w = 8.8mm, t_f = 14.3mm, r = 10.2mm, E = 205KN/mm, b = 89.4mm. $W_{el,y}$ = 1139cm^2

SECTION CLASSIFICATION

Strength Classification: If the t_f < 16 use p_y=275N/mm^2 as the design strength of steel: (cl. 3, table 9 of BS 5950). Hence, E = (275/P$_Y$)$^{1/2}$ = (275/275)$^{1/2}$ = 1.0 (Clause 3.1.1, table 9, 11).

Flange: b/T < 9E; b = B/2 = 178.8mm/2 = 89.4mm; b/T = 178.8/ 14.3 = 6.25. Therefore, b/T = 6.25 < 9E (Flange is plastic class 1).

web: d/t < 80E; d = D -2T - 2r = 409.4 - 2(14.3) - 2(10.2) = 360.4, d/t = 360.4/ 8.8 = 40.9. Therefore, d/t = 40.9 < 80E (Web is plastic class 1) clause 1.4.5

SHEAR BUCKLING

According to the code practice 0f BS 5950 when d/t > 70E check for local buckling will be considered then, but since d/t = 40.9 < 70E, shear buckling need not be considered. (clause 4.4.4).

SHEAR CAPACITY

$P_V = 0.6P_yAV$

$P_V = 0.6P_y t_w x D$ = 0.6 x 275 x 8.8 x 409.4 x 10^{-3} = 594.45 KN

But design shear force $(F)_V$ = (179.8) < P_V (594.45 KN), section is (OK) for shear.

Now $0.6P_V$ = 0.6 x 594.45 KN = 356.67 KN

Since F_V = (179.8KN) <0.6P(356669.28KN) We have lower load.

MOMENT CAPACITY

Design moment = 359.6KN, Moment capacity of section UB = 406 x 178 x67, P_yS =1346cm^3 x10^{3}mm^3.

$M_C = PS_y$ = 275N/mm^2 x 1346cm^3 x 10^3 =370150000Nmm/ 10^6 = 370.15 KN/m.

$1.2P_yZ$ = 1.2 x 275N/mm^2 x 1189cm^3 =392.370 / 10^3 = 392.37KNm.

M_C(370.15 KN/m) < 1.2P Z_y (392.37KNm), Hence section is (OK).

Evaluating extra moment due to self- weight of the beam self-weight of the beam S_w = 67.1kg/m /100 =0.671kNm (UDL on the beam). Moment due to self-weight (M_{sw}) = (ql^2)/8 = (0.671 x 8^2)/8 = 5.368KNm.

(359.6KN + 368KNm) < M_C(370.15 KN/m) < 1.2P_y Z (392.37KNm) Hence section is (OK) for Moment resistance.

DEFLECTION CHECK

We check deflection for the nonfactored impose load. E = 205KNmm^2 x 10^{6}KN/m, I_x=24330cm^4 x10^{-5}. The maximum deflection for this structure occurs at the mid-span and it is given as;

S = (5Wl^3)/384EI

5 x 12 x 8^3 x 1 x 10^3 / 384 x 205 x 24330 = 12.83mm.

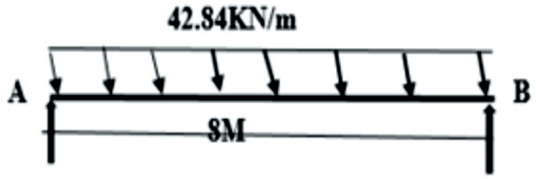
Permissible Deflection: L/360 = 8000 / 360 = 22.22mm.

12.83mm < 22.22mm. Therefore, deflection is satisfactory.

EUROCODE 3 BEAM DESIGN

ULTIMATE LOAD:

$1.35G_K + 1.5Q_K$; 1.35(18.4) + 1.5(12) = 42.84KN/m



H = 0, H_A = 0, V =0

$V_A + V_B$ = 42.84KN/m x 8 =342.72KN/m.

MOMENTS CALCULATION

Moment about A;

42.84 x 8(8/2) - V_A(8) = 0

$8V_A$ = 42.84 x 8(8/2)

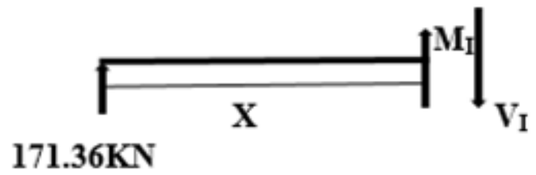
= 137088/8 = 171.36KN

Moment about B;

V_A(8) - 42.84 x 8(8/2) = 0

= 137088/8 = 171.36KN

.. $V_A + V_B$ = 171.36KN + 171.36KN = 342.72



V_1 = 0

171.36 - 42.84(x) = V

At, X = 0, V= 171.36

At, X = 2, V= 85.68

At X = 4, V= 0

M_1 = 0

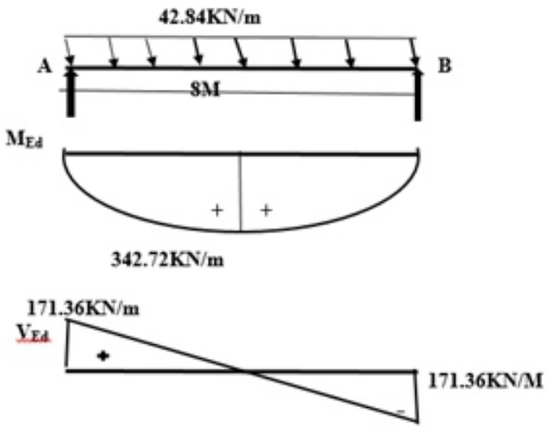
171.36(x) - 42.84(x)(x/2) = M

171.36(x) - 42.84(x^2)/2 = MI

At, X = 0, M= 0

At, X = 2, M= 257.04

At X = 4, M= 342.72



Steel Grade = S275

S275 is to be used for this design, Yield strength (F) = 275N/mm^2, Ym_0 = 1.0 (clause 6.1.1, NA 2.15, BS EN 1993-1-1:2005).

Section of plastic modulus about the y-y axis that is greater than z,z.

$w_{pl,y}$ = My, Ed Ym_0/F_y.

$w_{pl,y}$ = 342 x 10 x ^{3}1.0/ 275 = 3427200 / 275 = 1246.254cm^3

From universal beam properties table BS 1993

$w_{pl,y}$ = 1287cm^3, Beam section = 457 x 152 x 60, M =59.8kg/m, h = 454.6mm, b =152.9mm, t_w = 8.1mm, t_f = 13. 3mm, r = 10.2m, I_y = 25500cm^4, I_x = 795cm, ^{3}A = 76.2cm^2, d = 407.6mm.

E (Elastic modulus) = 210000N/mm^2. (clause 3.2.6(1)

CLASSICIFATION OF SECTION: (Clause 5.5.2)

$E = (275/F_y)^{1/2} = (275/275)^{1/2}$ = 0.92. (Table 5.2, BS EN 1993-1-1:2005)

Outstand flange; In compression: c = [b - t- 2r) = (152.9 - 8 .1 -2(10.2)] = 124.4/2 =62.2mm.

C/t_f = 62.2/ 13.3 = 4.6766, c/t< 9E; 9E = 9 x 0.92 = 8.28,

4.6766 < 8.28. Outstand flange in compression is plastic class 1 (OK).

considered.

(web under pure bending): Interval compression part:

C = d = 407.6mm, c/t_w = 407.6 / 8.1 = 50.32

Limiting value for class 1 c/t_w < 72E; 72E = 72 x 0.92 = 66.24 .. 50.32 < 66.24, web is plastic (OK) class 1.

MEMBER RESISTANCE VERIFICATION

Moment resistance; For the structure under consideration, the maximum bending moment occurs where the shear force is zero. Therefore, the bending moment does not need to be reduced for the presence of shear force (clause 6.2.8(2). $M_{Ed}/M_{C,Rd}$ < 1.0 (clause 6.2.5)

$M_{C,Rd} = W_{Pl,Rd} = (W_{Pl,y} x F_y)/Ym0$

$M_{C,Rd} = W_{Pl,Rd}$ = [(1287 x 275)/1.0] x 10 = 353.925

$M_{Ed}/M_{C,Rd}$ = 342.72/ 353.925 = 0.96 < 1.0 (OK)

SHEAR RESISTANCE (clause 6.6.2)

The design requirement is $V_{Ed}/V_{C,R3d}$ < 1.0

$V_{C,Rd} = V_{Pl,Rd} = A_v(F/3^{1/2})/Ym_0$ for class 1 section.

For rolled I-section with shear parallel to web, the shear area is;

A_v = A -(2b t) + (t + 2r)t; (For class 1 section) but not less than nh_w/t_w.

A_v = (76.2 x 10^2-(2 x 152.9 x 13.3) + (8.1 + 2(10.2)) x 13.3 = 3931.91mm^2.

π=1.0(conservative factor), πht_w =(1.0 x 428 x 8.1) =3466.8mm^2.

3931.91mm^2 > 3466.8mm. .. A_V = 3931.91$mm;^2$

Shear Resistance is therefore;

$V_{C,Rd} = V_{Pl,Rd} = A_V (F/3^{1/2})/ ¥m_0$ =(3931.91 x (275/$3^{1/3}$)/1.0)x10^{-3} = 624274.5567/1000 = 624.27KN

$V_{Ed}/V_{C,Rd}$ < 1.0; $V_{Ed}/V_{C,Rd}$ = 171.36/ 624.27= 0.28, 0.27 < 1.0 (OK).

SHEAR BUCKLING

Shear buckling of the unstiffened web will not need to be consider if ht_w < 72E/n; (h=h -2t); ht_w = 428 / 8.1 = 52.8; 72E/n = (72 x 0.92)/ 1.0 = 66.24: ht_w < 72E/n = 52.8 < 66.24, shear buckling need not be

SERVICEABILITY LIMIT STATE:

Vertical deflections are completed base on variable loads (q_k). Permanent load (g_k) need not be considered;(BS EN 1993-1-1 NA2.23). Q_K = 12KN/m. W = 5ql/384EI = (5 x 12 x 8)/ (384 x 21000 x25500 x10) = 11.95mm.

Span/360; = 8000 / 360 = 22.222mm (BS EN 1993-1-1NA2.23)

11.95mm < 22.222mm. .. Deflection is satisfactory.

Table 1. RESULTS COMPARISON AND DISCUSSION OF BS 5950 AND EUROCODE 3

CHECKS	BS 5950	EUROCODE 3
Loads /Actions	44.96KN/m	42.84KN/m
Design Shear Force	179.8	171.36
Design Maximum Bending Moment	359.6	342.72
Steel Section Size	406 x 178 x 67	457 x 152 x 60
Steel Weight	67.1 kg/m (0.54Tons) for 8m length.	60kg/m (0.48Tons) for 8m length.
Classification of Section: Flange	6.25 < 9E	4.67 < 9E
Web	40.9 < 80E	50.32 < 72E
Local/ Shear Buckling	d/t > 70E 40.9 > 70E need not be considered according to code.	h_w/t_w < 72E/n 52.8 < 66.24 need not be considering according to code.
Shear Resistance/ Capacity	594.45 KN	624.27 KN
Moment Resistance/ Capacity	370.15KN/m	353.925
Deflection/ Serviceability Limit	12.283mm	11.95mm

CONCLUSION

This study considered the basic design checks requirement of a given universal steel beam in comparison to satisfactory standards of BS 5950 and Eurocode 3 and it influence on loading, shear force, local buckling and serviceability limit of both codes. Findings from the study proves that Eurocode 3 is safe, workable, economical and advantageous compare to BS 5950.

In spite the enormous design checks, Eurocode 3 makes it complex, tasking and pain taking. Both codes have different symbols and basic designs requirement. Furthermore, the design analysis of this study is plastic class 1 of universal steel beam for both codes. Class 1 cross-sections are fully effective under pure compression, and are capable of reaching and maintaining their full plastic moment in bending (and may therefore be used in plastic design. (Leroy, G. A. *et al.,* 2011).

However, the primary objectives of structural design is to design a safe structure that will fulfill its intended purpose. The structure should be able to resist the predicted loads for its entire design life with a sufficient margin of safety. The in-service deflections and behavior of the structure must not be such that it is unacceptable for the intended use. Other factors that should also be considered in the design stage are erection, maintenance and sustainability. Hence, findings from the study shows that the design of steel structure is more economical, and advantageous using Eurocode 3 compared to BS 5950.

RECOMMENDATION

From the study, it is proven that Eurocode 3 is advantageous, safe, workable and economical compared to BS 5950 for their given beam section. This findings is in agreement with the work of Han (2006) on Eurocode 3. Although this may be cause by the use of different grade of steel section and classification of beam section. This project result analysis recommends Eurocode 3 to be economical, safe and workable. This research also give space for future studies, research and checks analysis.

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ASUP ZONE D

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COMPARATIVE STUDY OF THE QUANTITATIVE PHYTOCHEMICAL, VITAMIN AND MINERAL COMPOSITION OF *Ocimumbasilicum,Ocimumgratissimum*., *Ocimumcanum* and *Ocimum sanctum* (Family-Lamiaceae)

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COMPARATIVE STUDY OF THE QUANTITATIVE PHYTOCHEMICAL, VITAMIN AND MINERAL COMPOSITION FOUR OCIMIUM SPECIE

ABSTRACT

The objective of this study is to make a comparative analysis of the phytochemical, mineral and vitamin compositions of the leaves of Ocmiumbasilicum, O. gratissimum., Ocimumcanum and Ocimum sanctum (Family: Lamiaceae). The analyses were evaluated in accordance with standard procedures and the result compared. Of the four species investigated there was a significant diffference at (P<0.05) in their compositions. O. basilicumcontained significantly highest alkaloid (2.47±0.03) and steroids (0.23±0.03) but lowest in flavonoids, phenols and tannins. The highest yield of flavonoids (1.44±0.02) and tannins (0.90±0.03) was recorded by O. gratissimum. O. sanctum recorded lowest yield in steroids (0.16±0.00) and saponins (0.24±0.00). Also, potassium, calcium, iron and zinc were significantly predominant in O. basilicumcompared to the other species. O. sanctum recorded the highest percentage yield of vitamins A (29.53 ±0.17), B_1(0.61±0.01) B_2(0.44±0.01)andE (12.73±0.04). O. gratissimum showed the highest yield of Vitamin C (13.62±0.04) while O. canum had the highest yield of Vitamin B_3(0.53±0.01). The study revealed that theOcimumspeciest evaluated contained varying amount of the vitamins, minerals and phytochemicals, hence, their regular use and consumption is recommended for their medicinal and nutritional purposes.

Keywords: *LamiaceaOcimum, phytochemicals, minerals, vitamins*

INTRODUCTION

The genus Ocimum is a member of the Lamiaceae family consisting of annual and perennial aromatic with more than 150 species. The best-known important species of the genus include *Ocimum sanctum* L (Tulsi)., *O. gratissimum* (Ram Tulsi), *O. canum* (Dulal Tulsi), *O. bascilicum* (Ban Tulsi), *O. kilimandschricum, O. americanum, O. camphora* and *O. micranthum*that grow in different parts of the world and are known to have medicinal properties (Gupta *et al*.,2002). These plants known as aromatic or spices have gained much importance in recent years for both synthesis of drugs and industrial uses as food supplements. Plants are the cheapest and most available sources of important nutrients, supplying the body with minerals, vitamins and some hormone precursors, protein, energy and essential amino acids (Amaechi, 2009). The leaves of *Ocimum species* are used in the preparation of delicious local soups as well as flavouring agent in yam and cocoyam porridges in the Yoruba and Igbo tribes of Nigeria. The plant is also used as a local condiment because of its aromatic properties (Bassole *et al*., 2005).Recently in Nigeria, increased interest has been observed in the use of herbs to improve health. Culinary herbs are as important today as they were in ancient times for enhancing the flavour and taste of our foods as well as serving as a source of dietary medicine (Uhegbu*et al*., 2011). The diets of most Nigerians are high in carbohydrates and deficient in protein.

Furthermore, minerals cannot be produced by human and farm animals and as such they must eat mineral rich plants including leafy vegetables and water (Anjorin *et al.,*2010). However, lack of knowledge pertaining to the nutritional properties and presence of some phytochemicals are the major reasons for underutilization of these species. Despite various reports available on medicinal plants, detailed comparative nutritional information on these leaves is scarce. However, to understand the roles played in human and animal nutrition, knowledge of vitamin, mineral and phytochemical composition is fundamental to the understanding of the mode of action of these medicinal plants in general. The study will be useful for the nutritional education of the public as a means to improve the nutritional status of the population. Hence, the objective of this study is to quantitatively analyzed the phytochemical, mineral and vitamin compositions of the leaves of *Ocimum species* that are commonly found within our vicinity.

MATERIALS AND METHODS

Collection and identification of plant materials

Fresh leaves of *Ocimumgratissimum* and *Ocimumcanum* were collected. The plants were identified by Dr Nwokocha N. J. a botanist at the Department of Biology /Microbiology, Abia State Polytechnic Aba Abia State.

Sample Preparation for Analysis

The leaves of the plant were first separated from the stalk, rinsed with water to remove dirt; air dried at room temperature and ground to fine powder using an electric blender. The aqueous extracts of the samples were determined by soaking 50 g of dried powdered samples in 10 ml of distilled water for 12 hours. The mixture was filtered using Whatman no 42-filter paper and excess water removed by concentration of boiling the extract to 100 ^{0}C for 10 minutes and then transferred to labeled sterile bottles for the analysis.

Quantitative Phytochemical Analysis

Quantitative phytochemical composition of the leaves was determined using the methods of Okwu (2005) and AOAC (2005)

Alkaloids Content

This was done by the alkaline precipitation gravimetric method. Each of the samples (5 g) was

weighed into a 250 ml beaker and 200 ml of 20 % acetic acid in ethanol (1:10) was added and covered to stand for 4 hrs. This was filtered and the extract was concentrated using water-bath to one quarter of its original volume by evaporation and treated with drop-wise addition of concentrated aqueous NH_4OH until alkaloids was precipitated. The whole solution was allowed to settle and the precipitate was collected by filtration which was later dried and weighed. The alkaloid content was calculated and expressed as mg/100 g of the weight samples analyzed.

Tannins Content

Tannins content was determined by the photometric method The samples (5 g) was weighed into 100 ml plastic bottle. Then. 50 ml of distilled water was added and shaken for 1 hr in a mechanical shaker. This was filtered into a 50 ml volumetric flask and made up to the mark with distilled water. Then 5 ml of the filtrate was pipette out into a tube and mixed with 3 ml of 0.1 M $FeCl_3$ in 0.1N HCL and 0.008 M potassium ferrocyanide. The absorbance was measured in a spectrophotometer at 760nm wavelengths, within 10 minutes. A blank sample was prepared using the extraction solution (distilled water). A standard solution of tannic acid (5 mg/ml) was prepared and with the blank reagent at zero the standard absorbance was measured at 760 mm wavelength.

Saponins Content

Each of the plant samples (5 g) was dispersed in 200 ml of 20 % ethanol. The suspension was heated over a hot water bath for 4 hrs with continuous stirring at about 55^{O}C. The mixture was filtered and the residue re-extracted with another 200 ml of 20 % ethanol. The combined extracts were reduced to 40 ml over a water bath at about 90 ^{O}C. the concentration was transferred into a 250 ml separator funnel and 20 ml of diethyl ether was added and shaken vigorously. The aqueous layer was recovered while the ether layer was discarded. The purification process was repeated after which n-butanol (60 ml) was subsequently added and the combined n-butanol extracts were washed twice 10 ml of 5% aqueous sodium chloride. The remaining solution was poured into a dried pre-weighed crucible and dried in an oven at 60 ^{o}C to a constant weight.

Flavonoids Content

The total flavonoid content of plant extract was determined as described by Okwu (2005). Each of the plant samples (5 g) was weighted into 100 ml plastic bottle and extracted repeatedly with 100 ml of 80 % aqueous ethanol at room temperature. It was filtered with Whatman No 42-fitter paper into 100 ml flask. The filtrate was transferred into a crucible dish and evaporated to dryness over a water bath. This was further dried in an oven at 60 ^{o}C at 30 minutes and cooled in desiccators. The crucible and the content were weighted and recorded.

Total Phenolic Content

Total phenol content was determined using the Harborne method as described by Okwu. (2005 For the extraction of the phenolic component, the sample was boiled with 5 0ml of ether for 15 minutes. The extract (5 ml) was pipette into a 50 ml flask, and 10 ml of distilled water was added. 2ml of ammonium hydroxide solution and 5ml of concentrated amyl alcohol were also added. The samples were left to react for 30 minutes for colour development. The absorbance of the solution was read using a spectrophotometer at 50 5nm wavelength. A blank sample for each extract was used for background subtraction. A standard phenol was prepared as 0.05mg/l and absorbance measured. The total phenolic content was expressed as mg/100 g.

Mineral Analysis

Determination of Mineral Content. Iron, Zinc, Copper, Magnesium, Manganese, Sodium and Potassium and Calcium were determined according to the standard method of AOAC (2005) using an Atomic Absorption Spectrophotometer (AAS) after acid digestion of the sample. The digested samples were analyzed for minerals using their different methods of analysis. Flame photometer was used to determine calcium, magnesium, potassium and sodium contents while Atomic Absorption Spectrometer was used for the determination of Phosphorus, Iron and Zinc.

Determination of Vitamins

The vitamin contents of the leaves were determined by methods described by Paul and Pearson (2005), Okwu and Josiah 2(006), Nkafimya*et al* (2007) and AOAC, (2005).

5g of the sample was extracted with 100ml of 50% ethanol solution and shaken for 1 hr. This was filtered into a 100ml flask. 10 ml of the extract was pipette into 50 ml volumetric flask. 10 ml of 5% potassium permanganate and 10 ml of 30%

H

2

O

2

were added and allowed to stand over a hot water bath for about 30 min. 2 ml of 40 % sodium sulphate was added. This was made up to 50 ml mark and the absorbance measured at 510 nm in a spectrophotometer 5g of the sample was extracted with 100 ml of 50% ethanol solution and shaken for 1 hr. This was filtered into a 100ml flask. 10 ml of the extract was pipette into 50 ml volumetric flask. 10 ml of 5% potassium permanganate and 10 ml of 30%

H

2

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H

2

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2

were added and allowed to stand over a hot water bath for about 30 min. 2 ml of 40 % sodium sulphate was added. This

was made up to 50 ml mark and the absorbency measured at 510 nm in a spectrophotometer

Determination of Riboflavin:

5 g of the sample was dispersed in 100 ml of 50 % ethanol solution and shaken for 1 hr. This was filtered into a 100 ml flask. 10 ml of the extract was pipette into 50 ml volumetric flask. 10 ml of 5% potassium permanganate and 10 ml of 30 % H_2O_2 were added and allowed to stand over a hot water bath for about 30 min. 2 ml of 40 % sodium sulphate was added. This was made up to 50 ml mark and the absorbance measured at 510 nm in a spectrophotometer.

Determination of Niacin:

5 g of the sample was dispersed in 50 ml of 1 N sulphuric acid and the suspension shaken for 30 minutes then 3 drops of ammonia solution were added to the sample and filtered. 10 ml of the filtrate was pipette into a 50 ml volumetric flask and 5 ml of potassium cyanide was added. This was acidified with 5 ml of 0.02 N $H_2SO_4$and absorbance measured

in the spectrophotometer at 470 mm wavelengths. This was used to plot the calibration curve.

Determination of Thiamin:

5g of the sample was homogenized with 50 ml ethanol sodium hydroxide and was filtered into a 100 ml flask. Then 10 ml of the filtrate was pipette and on addition of 10 ml of potassium dichromate the colour changed and was read at 360 mm. A blank sample was prepared and the colour also developed and read at the same wavelength

Determination of Vitamins A

Vitamin A and E concentration was determined by the spectrophotometric method (Spectrophotometer SEAC, Italy) as described by Pearson [22]. For Vitamin A, to 1g of plant sample was added ethanol (3ml) to precipitate the proteins before extraction with heptane (5ml). After vigorous shaking the heptane layer was separated and absorbance read at 450nm against a heptane blank using a UV/Vis spectrophotometer (SEAC, Italy). A standard was also prepared and read at 450nm. Vitamin A from sample was calculated from the known concentration of standard.

Determination of Vitamins E

For the determination of Vitamin E, a weighed sample (1 g) was macerated with petroleum ether (20 ml), filtered and the filtrate evaporated to dryness and re-dissolved in ethanol (2 ml). To the re-dissolved sample was then added 1 ml each of 0.2% Ferric chloride and 0.2% dipyridyl (both dissolved in ethanol) and the mixture made up to 5 ml with ethanol. The solution was mixed thoroughly and absorbance taken at 520nm using a UV/VIS spectrophotometer (SEAC, Italy) against a corresponding blank. A standard was also prepared and read at 520 nm. Vitamin E from sample was calculated from the concentration of the standard.

STATISTICALANALYSIS

Statistical analysis of the samples done in triplicates using SPSS version 15.0. Mean value was carried out using Duncan Multiple Range test and Analyis of Variance (ANOVA) was conducted on the mean values to determine the significance of the difference between the samples.

RESULTS AND DISCUSSION

The phytochemical analysis of the four *Ocimum* leaves revealed that alkaloids, flavonoids, steroids phenols, tannins and saponins were present in the leavesThe result of the percentage phytochemical analysis of *Ocimum* species as shown in table 1 reveals that *O. basilicum* contained highest amount of alkaloid (2.47±0.03) and steroids (0.23±0.03). The highest percentage yield of flavonoids (1.44±0.02and tannins (0.90±0.03) were recorded by *O. gratissimum*. *Ocimumsantum* recorded the highest yield of phenols (0.34±0.00) while *O. canum*recorded the highest percentage of saponins (0.40±0.00). Thephytochemical was significantly different at ($p<0.05$) at the varying concentrations.The alkaloids and flavonoids were significantly predominant among the phytochemical studied. However, alkaloids (2.47%) and steroids (0.23%) were highest in *O.basilicum* Also, flavonoids (1.44%) and tannins (0.90%) were highest in *O gratissimum*. *Ocimumcanum* had highest content of saponins and the highest content of phenols was obtained in *O. Sanctum*.

DISCUSSION

The analysis of the four l species of *Ocimum* revealed r the presence of a variety of secondary metabolites which include alkaloids, tannins, saponins, steroids, phenol and flavonoids. The presence of alkaloids, flavonoids and saponins, and phenols in the leaves supported the report of Edeoga*et.al* (2006). This is in

agreement with the work of Geyid*et al*. (2005) and Tedong*et al*. (2006) who reported that plants generally have variety of secondary metabolites as shown in this study. The variation in the phytochemical constituents may be associated with the inherent genetic diferent among the species studied as well as the environmental condition of various locations (Okuniola*et al*., 2017).

The beneficial medicinal effect of the plant materials result from the combination of these metabolites present in the plants (Ndukwe*et al*. 2013). Saponin is used in medicine and pharmaceutical industries because of its foaming ability with frothy effect. Flavonoids are well known antioxidant. Alkaloids are known to play some metabolic roles. The compound has protective role in animal and its constituents of most valuable drugs. The presence of tannins is responsible for the astringent flavour in the leaves.

Table1: Percentage Quantitative phytochemicals screened *Ocimum* species

Samples	Alkaloid	Flavonoid	Steroids	Phenols	Tannins	Saponin
Ocimumcanum	2.34±0.08	1.37±0.03	0.18±0.18	0.28±0.28	0.85±0.01	0.40±0.00
Ocimum sanctum	2.46±0.08	1.41±0.02	0.16±0.00	0.34±0.00	0.84±0.00	0.24±0.00
Ocimumgratissimum	2.33±0.03	1.44±0.02	0.17±0.00	0.28±0.01	0.90±0.03	0.28±0.00
Ocimumbasilicum	2.47±0.03	1.35±0.01	0.23±0.03	0.25±0.00	0.83±0.01	0.26±0.00

Minerals are needed in the body because they form the structure of the body and help the body systems work effectively. The result revealed that *O. basilicum* was significantly highest($p<0.05$) in potassium, calcium, iron and zinc at 219, 22.76,1.96 and 0.76 mgly respectively compared to other species. However, *O sanctum* was significantly highest in sodium and magnesium 68.37 and 83.51 mg/g while the lowest values of sodium 62.43 and magnesium 75.24 mg/g were obtained in *O. basilicum*. These macro elements are required for the normal functioning of the nervous system and play a vital role in regulating blood pressure. It has been recommended that Na/K ratio less than 1 will prevent high blood pressure (FDN, 2002).

Calcium is a vital element in building and maintaining strong bones and teeth. It is essential for blood clotting, maintenance of blood pressure and as a cofactor in enzymatic processes (Akubugwo*et al.,* 2007). The higher concentration of calcium in *O. basilicum* and*Ocimumgratissimum* leaves than in leaves of the other species makes them good sources of nutrients for the elderly who are predisposed to osteoporosis.The consumption of food rich in micronutrients such as iron has built a strong immune system and food nutrient absorption, utilization and digestion (Njoku and Ohia 2007) iron is also known to play a vital role in hemoglobin control or indication and cell medicated immune (Barua *et al*. 2015)

Iron is involved in oxygen binding to hemoglobin thereby playing a vital role in blood formation Hence, the supplementation of the diet with *ocimum* leaves can help to combat the problem of iron deficiency anemia

Table 2: Mineral composition of the studied *ocimum*species

Samples	Na	K	Mg	Ca	Fe	Zn
Ocimumcanum	67.54± 0.37	215.62± 0.03	81.66± 0.06	22.68± 0.10	1.88± 0.02	0.71± 0.02
Ocimum sanctum	68.37±0.04	219.51±0.16	83.51±0.13	22.75±0.08	1.84±0.02	0.64±0.01
Ocimumgratissimum	65.54±0.08	216.72 ± 0.03	78.56 ± 0.06	22.46 ±0.03	1.85±0.01	0.74±0.03
Ocimumbasilicum	62.43±0.04	219.66±0.06	75.24±0.08	22.76±0.32	1.91±0.01	0.76±0.01

VITAMINS

Table 3: Vitamin analysis of screened *Ocimum* species (%)

Samples	Vitamin A	Vitamin B_1	Vitamin B_2	Vitamin B_3	Vitamin C	Vitamin E
Ocimumcanum	27.96±0.36	0.51±0.00	0.26±0.01	0.53±0.01	13.48±0.03	11.32±0.04
Ocimum sanctum	29.53±0.17	0.61±0.01	0.61±0.01	0.49±0.00	13.51±0.03	12.73±0.04
Ocimumgratissimum	27.67±0.24	0.56±0.04	0.32±0.00	0.48±0.01	13.62±0.04	12.53±0.11
Ocimumbasilicum	26.84±0.01	0.51±0.00	0.28±0.00	0.47±0.03	12.96±0.06	11.78±0.03

Table 3 indicates that the plants species studied contained appreciable yield of the vitamins investigated. The vitamin compositions of the *Ocimum* species samples were reported in Table 3. Vitamin A is the most abundant vitamin found in the plant species followed by C > E > C B_1> B_2> B_3 respectively. The levels of vitamins range from 0.47±0.03 mg/g for *O. basilicum* to 29.53±0.17 mg/g in *O. sanctum*. *Ocimumgratissimum*showed the highest percentage yield of Vitamin C (13.62±0.04) while*Ocimumcanum*had the highest yield of Vitamin B_3(0.53±0.01).

O. sanctum recorded the highest percentage yield of vitamins A (29.53 ±0.17) Vitamin B_1 (0.61±0.01)Vitamin B_2 (0.44±0.01)andVitamin E (12.73±0.04).The green leaves *Ocimum* species contain high concentration of vitamins, minerals and oils (khare, 2007). These plants are good source of ascorbic acids, niacin, riboflavin and thiamine.Natural ascorbic acid is vital for the body performance (Okwu, 2004). Moreover, vitamin C is a water-soluble antioxidant whose high dietary intake is associated with reduced risk of colon cancer and inflammatory diseases (Pattison et al., 2004). The sufficient amount of vitamin C in the leaves *O. species* is an indication of the ability of the leaves to prevent the formation of carcinogens and scavenge free radicals which are formed during metabolic processes in humans.

CONCLUSION

The result obtained in this study revealed that leaves of *O species* contained appreciable amount of bioactive compounds and minerals and vitamins, therefore, the use of these plant materials as food spices and as alternate sources of food component is recommended.

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COMPARING THE COMPRESSIVE STRENGTH OF BORROW PIT SHARP SAND AND QUARRY DUST IN CONCRETE PRODUCTION

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ABSTRACT

Concrete is the most widely used composite material in the building industry presently. The increasing cost, scarcity as well as environmental degradation in some places attributed to the use of river sand and borrow pit sharp sand as fine aggregate for concrete production has led to the consideration of industrial crusher waste as alternative and complementary fine aggregate material for concrete production to enhance sustainability. The main aim of this paper is to assess and compare the compressive strength of concrete made with borrow pit sharp sand from IkotEkpene and quarry dust as fine aggregates respectively, with and without varied proportions. To achieve this aim, the paper was limited to the compressive strength for some structural members, beams and slabs. Coarse aggregate of size 10mm-15mm, and water cement ratio of 0.5 was used for a mixed ratio of 1:1.5:3 at a slump 0f 77mm2. A total number of 54 cubes were casted and cured for 7, 14 and 28 days respectively. Three cubes for each category were crushed using the compressive testing machine and the average taken as the compressive strength of the concrete. It was found that quarry dust had the average compressive strength of 26.93N/mm2, while borrow pit sharp sand had the average compressive strength of 24.42N/mm2. The results of this study are useful for construction managers and other participants in the building industry to become aware of the industrial crusher waste that can be used as a suitable alternative fine aggregate material for concrete production and enhance sustainability in the construction industry.

Keywords: *Compressive Strength, Quarry Dust, Borrow Pit Sharp Sand, Slump.*

INTRODUCTION

With the upsurge of population, there comes a continuous and rapid increase in urbanization. Due to this, there is a high demand for housing and other infrastructure; hence the demand for concrete and its constituents. Annually, it is estimated that 33 billion tons of concrete are manufactured globally;consequently, concrete has become the second most utilized material after water.(Ikponmwosa, E. E., and Ehikhuenmen, S. O. 2017). Concrete is a series of aggregates bonded together by a binder that hardens cement paste formed by hydration of Portland cement (Ambrose, E. E. and Forth, J. P., 2018).

Traditionally, river sand is used as fine aggregate in concrete production in Nigeria and most of other countries. However, the continual mining on rivers has caused environmental degradation and unchecked depletion in its natural reserve (Anya, U. C., 2015). Therefore, many sand mining sites have been shut down due to the damages caused on the environment. As a result, this has brought about

scarcity of sand. Furthermore, the scarcity of the product has resulted in high cost of transportation from relatively distant places. Hence, it becomes obvious that there is a need for an economic alternative for fine aggregate material. To remedy the problem, attempts have been to either partially or completely replace sand with other materials in concrete production. From these alternative materials arepit sharp sand and quarry dust. As an alternative, quarrydust have yielded the most commendable results. Evidence from research have shown that quarry dust can be used partially, and sometimes, wholly to replace natural sand in concrete.

Studies by Manasseh, J., 2010, Lohani, T. K., Padhi, M. and Jena, S., (2012), showed that the compressive strength of concrete is greatly improved when sand is partially replaced with quarry dust. (Manasseh, J., 2010, Lohani, T. K., Padhi, M. and Jena, S., 2012).Similar researchresult from Sukesh, C., Krishna, K. B., Teja, P. S. S. and Rao, S. K., (2013); posited that the use of quarry dust improves not just the strength of the properties but also the durability and the mechanical properties. (Sukesh, C., Krishna, K. B., Teja, P. S. S. and Rao, S. K., 2013). Fine quarry dust provides an added strength to concrete and mortar; this is evident in the work of Nagabhushana, Z.,Z. andBai, S. 2011. In their study, they compared the compressive strengths of concrete in which sand was partially replaced with quarry dust with its finer particles (<75 microns) removed from that in which they were included; the results showed a relatively higher outcome. (Nagabhushana, Z. Z. and Bai, S. 2011). The reason for this is that, finer particles help to create a more dense structure by effectively filling the spaces between the bigger particles. However, Sukeshetal., (2013), argued that the water demand for concrete with sand when partially replaced with quarry dust is relatively higher compared to when it is without inclusion for the same slump.(Sukeshetal., 2013). So, the more the quarry dust content, the greater the water it demand. Thus, the cement content when quarry dust is wholly used to replace sand in concrete becomes relatively higher. Consequently, the strength property of green concrete was enhanced when quarry dust and borrow pit sharp sand were used in place of river sand. Given these factors, it is probable that there will be a substantial increment in the cost of concrete. Hence, this paper aims to compare the comparative strength of concrete produced with and without varied proportions of quarry dust and borrow pit sharp sand from IkotEkpene in AkwaIbom State.

LITERATURE

Commonly, the strength of concrete is considered most valuable property. Although, in numerous practical cases, other characteristics such as; durability and permeability maybe of utmost importance(Neville, A., M. 2011). There is a link between the strength and structure of hydrated cement paste and it often gives an overall picture of the concrete's quality (Neville, A. M. 2011).

Studies have been carried out on the compressive strength of concrete, findings have it that the strength of concrete is invariably a vital element of structural design and has been specified for compliance purposes. Ephraim and Ode (2006),in a study on the suitability of concrete made with washed 10mm all-in aggregate yielded a characteristics strength value of about 20.80N/mm^2 at the optimum water cement ratio 0.50. The used of quarry dust as a fine aggregate (Ilangovana, R., Mahandrana, N., and Nagamanib, K., 2010), used 150mm x 150mm x 150mm test specimens to determine it compressive strength. From the study, the finding showed that the compressive strength of quarry dust concrete was comparatively 10-12 percent more than that of similar mix of conventional concrete.(Ephraim and Ode, 2006). Also, Waziri et al., (2011), tested the compressive strength of concrete made with quarry

dust as fine aggregate and found that the strength was greatly influenced by the water/cement ratio. (Waziri et al., 2011). However, Venkataet al., (2013) were of the view that the amount of quarry dust from the crushing process is 20-25% of the final product from stone crushing units. (Venkataet al., 2013).

In addition, Jaywardenaet al., (2006),noted that river sand can be obtained through dredging from river beds. (Jaywardenaet al., 2006). Still, Manasseh, J., (2010) opined that the cost of such project has skyrocketed and that the situation is responsible for limited supply for construction projects. (Manasseh, J., 2010).In Zongjin, L., (2011) view, compacting can make concrete denser and stiffer and thus have a good compressive strength and low permeability.(Zongjin, L., 2011). Therefore, the essence of compacting is to remove the air entrapped during concrete placement and to consolidate plastic concrete into all the spaces in the formworks and reinforce steels. In the absence of proper compacting, high-quality concrete cannot be achieved.

According to Alilou and Teshnehlab, (2010), they argued that ratio of water to cement is the chief factor for determining concrete strength. However, minimum amount of water is necessary for proper chemical action in the hardening of concrete while extra water increases the workability but reduces strength. (Alilou and Teshnehlab, 2010).

CHARACTERISTICS OF RIVER SAND

River sharp sand has been the predominantly used and recommended fine aggregate for concrete production over the years. The characteristics of river sand would improve the workability of concrete and mortar compared to the use of their alternatives, such as crush rock fine (Manasseh, J., 2010). The use of river sand would, for a given workability requirement, reduce the water demand and or super plasticizer demand, and thus allow a lower water content and lower cement content to be adopted in the mix design. With lower salt and clay contents, the use of river sand would improve the quality control of the concrete/mortar production because the presence of too much salt and/or clay would adversely affect the workability and strength of the concrete/mortar produced (Manasseh, J., 2010).

FEATURES OF QUARRY DUST AND BORROW PIT SHARP SAND

The mix ratio of quarry dust used as portion of natural sand should not be detrimental to strength development. Therefore, the mix designs should aim at having a significant gain in strength comparable to that of borrow pit sharp sand. It is likely that the use of quarry dust might have effect on the workability of the mix depending on the quality and quantity of the quarry dust. As such, a constant slump of 60-80mm range must be maintained for comparison purposes. Quarry dust as portion replacement of borrow pit sharp sand should not impact on shrinkage; therefore, shrinkage is expected to be with the accepted range.(Neville, 2002).

By way of classification, borrow pit sharp sand is classified as coarse sand which is procured from deep pits of abundant supply and it is generally in grey-yellowish color. The coarse grain is sharp and angular which is mostly employed in concreting.(Serene Interiors; 2017).

RATE OF APPLICATION OF LOAD

Often, the rate of application of load has a measurable impact on the strength of test results. If the rate of application of load is slow or there is some time lag, then it will result into lowervalues of strength, (Padhi, S. 2017). Given the slower application of load, the specimen will undergo some amount of creep which in turn increases the strain and the increased strain is responsible for failure of test sample which amounts to lower strength values. Mishra, (2008) indicated that the degree of hydration is synonymous with the

age of concrete provided the concrete has not been allowed to dry out or the temperature is too low. Generally, it is accepted that about 90% of the strength is achieved by 28 days for convenience and most cases in practical application.

RESEARCH METHODOLOGY

Here, the procedures and methods employed in data collection are presented. The research is descriptive and it employed a quantitative research approach. Series of laboratory work was carried out in order to measure the compressive strength of concrete produced with and without varied proportion of quarry dust and borrow pit sharp sand. Concrete specimens were collected from the materials laboratory of Civil Engineering Department, AkwaIbom State Polytechnic, IkotOsurua, IkotEkpene, AkwaIbom State.

The suitability of using the aggregate for construction work was determined at the laboratory. The paper was limited to the compressive strength of concrete for beams and columns and compressive strength of 25N/mm² with coarse aggregate of 10-15mm nominal size and water/cement ratio of 0.5 was used for mixed ratio of 1:1.5:3 at a slump of 77mm. portable drinking water was found to be suitable for concrete work (British Standard 3148, 1980). The mix composition was computed using the batching by weight method. The casting, curing and testing of specimen were carried out on 3 sets of mix constituent as shown in Table 1. The required weight of the mix constituent was measured and mixes thoroughly, using a concrete mixer to ensure that homogenous mix was obtained. Slump of concrete was measured in accordance to British Standard (BS) 1881: Part 102, (1983) before casting. For each type of mix 9 cubes (150x150x150mm) was cast in accordance to British Standard (BS) 1881: Part 108 (1983).

The concrete cubes were de-molded, after a day of castingand transferred to a water tank for curing until the time of test. The curing of the cubes was done in accordance to British Standard (BS) 1881: Part 111 (1983). The concretes were tested for compressive strength at 7, 14 and 28 days at which the maximum strength is attained. Three cubes each was crushed using the compressive testing machine and average taken as the compressive strength of the concrete.

MIX CONSTITUENT

Fine Aggregate	Mix Proportion	No. of Specimen
Quarry dust	100%	9
Pit sand	100%	9
Quarry dust added with pit sand	50% added with 50%	9

The test involved twenty seven concrete specimen of standard cubes of size 150x150x150mm cast, cured and tested. Three (3) cubes each of the mix were used to determine the compressive strengths at various ages (7days, 14 days, and 28days) at the proportions of 100% of quarry dust, 100% for pit sand, quarry dust (50%) and pit sand (50%), therefore 9 concrete cubes each for the mix was tested. Concrete cubes (150mm) were mixed before they were cast and cured in water until testing on the 7, 14 and 28 days. Each mix of 9 cubes was cast. Three (3) cubes of each mix was tested each day with digital compressive strength machine capacity of 1500KN. Compression was done in the laboratory to check that the cured concrete had obtained the required designed strength. Each cube was crushed once in the compressive machine.

RESULTS AND DISCUSSION

This section presents results from the laboratory experiments on concrete produced with and without varied proportion of quarry dust and borrow pit sharp sand to determine the compressive strength of concrete. Table 1 shows that quarry dust had the average compressive strength with mean of 26.93 N/mm^2 during the four weeks period of experiment.

MIX CONSTITUENT

Fine Aggregate	Mix Proportion	Number of Specimen
Quary dust	100%	9
Pit sand	100%	9
River sand	100%	9
Quarry dust and pits sand	60% + 40%	9
Quarry dust + sand river	60% + 40%	9
Pit sand + river sand	60% + 40%	9

Table 1: Distribution of Descriptive Statistics for compressive strength of concrete produced without varied proportion

Days of Concrete	Concrete Type	Mean strength N/mm^3	No. of Samples
7 days	River Sand	21.50	3
	Quarry dust	19.50	3
	Pit sand	18.70	3
	Total		**9**
14days	River Sand	24.10	3
	Quarry dust	21.17	3
	Pit sand	20.32	3
	Total		**9**
28 days	River Sand	29.10	3
	Quarry dust	26.93	3
	Pit sand	24.42	3
	Total		**9**

The study went ahead to check the trend of compressive strength of concrete produced with varied proportion of sand as seen in table 2, the compressive strength of other concrete produced with varied proportion of quarry dust and pit sand varied in strength. The study further sought to find the compressive strength with respect to days.

Table 2: Distribution of Descriptive Statistics for compressive strength of concrete produced with varied proportion of 50% each

Days of Concrete	Concrete Type	Mean N/mm^2	No of Samples
7 days	Quarry dust added with Pit sand	23.13	3
	Total		**3**
14 days	Quarry dust added with Pit sand	24.00	3
	Total		**3**
28 days	Quarry dust added with Pit sand	28.10	3
	Total		**3**

Table 3: Distribution of Descriptive Statistics for compressive strength of concrete produced with other varied proportions

Days of Concrete	Concrete Type		Mean strength N/mm^3	No. of Samples
	60%	**40%**		
7 days	Quarry dust	Pit sand	23.13	3
	Quarry dust	River sand	26.90	3
	Pit sand	River sand	24.5	3
	Total			**9**
14days	Quarry dust	Pit sand	24.00	3
	Quarry dust	River sand	27.5	3
	Pit sand	River sand	25.40	3
	Total			**9**
28 days	Quarry dust	Pit sand	28.10	3
	Quarry dust	River sand	30.30	3
	Pit sand	River sand	27.70	3
	Total			**9**

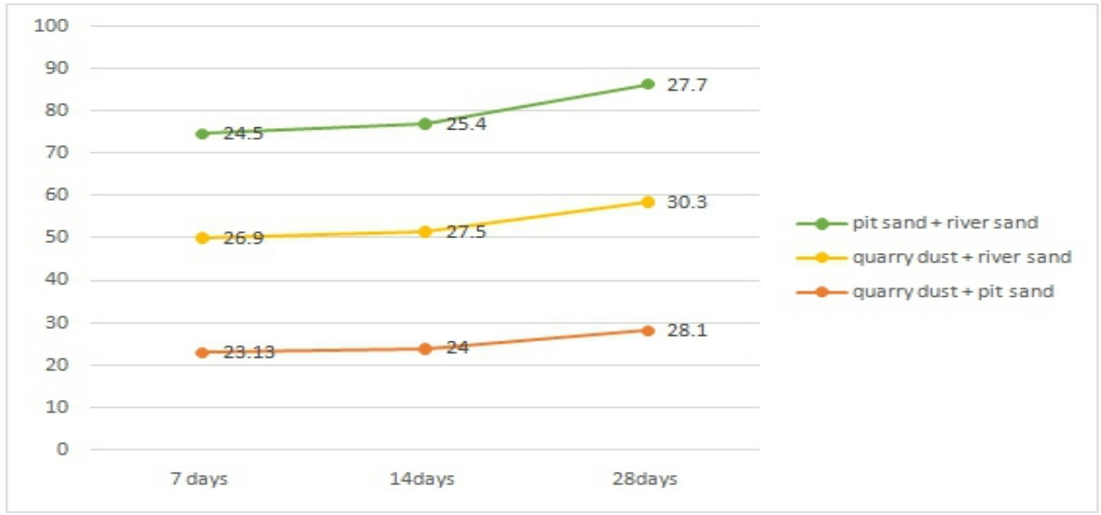
Table 4: Distribution of Descriptive Statistics for compressive strength of concrete produced with other varied proportions

Mix Constituent

Fine Aggregate	Mix Proportion	Number of Specimen
Quarry dust + pit sand	40% + +60%	9
Quarry + river sand	40% + 60%	9
Pit sand + river sand	40% + 60%	9

Table 4

Days of Concrete	Concrete Type		Mean strength N/mm³	No. of Samples
	40%	60%		
7 days	Quarry dust	Pit sand	23.13	3
	Quarry dust	River sand	26.90	3
	Pit sand	River sand	24.5	3
	Total			**9**
14days	Quarry dust	Pit sand	24.00	3
	Quarry dust	River sand	27.5	3
	Pit sand	River sand	25.40	3
	Total			**9**
28 days	Quarry dust	Pit sand	26.10	3
	Quarry dust	River sand	30.30	3
	Pit sand	River sand	25.70	3
	Total			**9**



Graph 1.0 showing the different mean strength of concrete made up of fine aggregates mixed at different proportions.

Result of the analysis from the laboratory experiments showed that quarry dust added with borrow pit sharp sand had an improved compressive strength of concrete produced with varied proportion of 50% each with an average mean of 28.10 N/mm^{2}and kept increasing with higher percentage of quarry dust, while River sand had the highest average compressive strength for the concrete produced without varied proportion with an average mean of 29.10 N/mm^2.

These values fall above the specified minimum compressive strength of 25N/mm^2 as referred to by the paper for columns and beams with coarse aggregate size of 10mm-15mm nominal size by practice for the 28days result.Hence, the use of quarry dust has proven to be a suitable alternative as well as with varied proportions to pit sand in concrete production as well as improved the quality control of the concrete/mortar production and workability of concrete and mortar. The presence of too much silt and/or clay, adversely affect the workability of and strength of the concrete/mortar produced with pit sand. For this reason, it was observed that the trend of compressive increased gradually in compressive strength at each curing stage.

CONCLUSIONS AND RECOMMENDATIONS

The paper compared the compressive strength of produced with and without varied proportion of quarry dust and pit sand from IkotEkpene in AkwaIbom State. River sharp sand had the highest average compressive strength for concrete produced without varied proportion. Moreover quarry dust added with pit sand hadan improved compressive strength for concrete produced with varied proportion. Days of curing concrete were also found to have a significant main effect on concrete compressive strength for concrete produced with varied proportion. The implication here is that the higher the days, the higher compressive strength. In addition, the quality of quarry dust and pit sand type had significant effect on the concrete compressive strength. Concrete produced without proportion point out quarry dust with the best compressive strength.

Additionally, age of concrete had no significant effect on compressive strength for concrete produced without varied proportion. However, proportion of quarry dust added with pit sand had a significant effect on the concrete compressive strength. Hence, construction industry should employ more the use of quarry dust with or without being added with pit sand during the production of concrete with varied proportion for quality work and good compressive strength.

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COMPARISON EFFECT OF OPTIMUM CURING CONDITIONS FOR CONCRETE BLENDED WITH CORNCOB ASH AS A CEMENTITIOUS MATERIALS FOR PAVING STONE.

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ABSTRACT

In this research an attempt is made to evaluate theComparisoneffect of curing conditions for concreteblended with Corncob Ash(CCA) as a cementitious materialfor paving stone. The study confirmed the strength performance of concrete with 0, 2.5, 5, 7.5 and 10% replacement of CCA at 7and 28days of curing maturity under four curing conditions namely spraying, immersion,air curing andcovering with moist sand with the targeted concrete strength of 20N/mm^{2}at 28days.The concrete was prepared in batches,in-filled the moulds andmanually compacted using steel rod at minimum strokes of 25 per layer to expel the entrapped air. The harden concrete was removed from the moulds after 24hrs and thereafter the specimens were cured for maturity regime of 7 and 28day. Experimental results indicate that CCA has a pozzolanic characteristicsand displayed downward results as the CCA content increases, thus shows that the optimum replacement level with CCA is at 5% replacement at allcuring age of 28days.In comparison the values of all the test performed depicts required strengths by substitutional mix in all curing conditions adopted andthe immersion water curingpractice has the optimum specimens' strength of 23.56N/mm^{2}compared to other curing approaches. The overall finding of the study recommended that concrete should be cure by immersion water method to achieve the best strength, experience for desirable quality of service for concrete production for paving stones, structural elements, cost of cure,feasibilityand durability performance.

***Keywords**: Compressive strength, Curing, Ages, Corncob Ash and Cement.*

INTRODUCTION

Paving stones are utilized in both residential and non-residential construction because of their unique features such as strength, superior surface quality, high stiffness, resistance to extreme temperatures, and creep resistance in continuous load and severe situations. Paving materials are available in a variety of forms. The increased emphasis on aesthetics is expected to boost the use of paving materials during the forecast period. However, high initial investments and environmental issues related to paving stones are expected to hinder market growth. Concrete paver stonesare the pre-casted solid blocks and it is made in the form of bricks consisting sand, cement and other materials. Concrete are materials with its versatile applications, satisfying performance in strength requirements, durability and its ability to be moulded into variety of shapes and sizes, (Kayode and Ilessama, 2015).

Nataraja and Lelin (2006) stated that interlocking stones have been extensively used in many countries for quite some time as a specialized problem-solving technique for providing pavement in areas where conventional types of construction are less durable due to many operational and environmental constraints. This extensive usage can also be attributed to its ability to allow seepage of underground water without losing its property of strength and durability, which is as a result of its interlocking arrangement as observed by Bean, Hunt, and Bidelspach (2007).

In recent years many industrially-related by-products such as fly ash, silica fume and carbon nanotubes are being incorporated to enhance the properties of cement paste or concrete byKarakouzian et, al. (2021). But in many countries, large amounts of agricultural waste materials such as corncob, sawdust,bagasse, banana stalks, rice husk, bamboo etc., are discarded as waste. Their disposal is causing serious environmental problems. Therefore, efficient utilization of these agricultural waste materials as a partial replacement for concrete is a good approach. Industrial waste is increasing day by day due to industries, which is a threat to our environment and onthe other hand uses of natural recourses also increases for construction purpose which is also a major threat to the environment. Waste like Corncob from maize is a byproduct of agricultural waste and the ashes are extraction during the process of burning and refining. Corncob Ash (CCA) are recycling of agro-wastes used in several researches to produced concrete because of its highly reactive pozzolanic material leading to a significant improvement in strength and durability of normal concrete. The recycling of agro-wastes and other supplementary cementitious materials use in concrete production and other construction materials, have gained impressive scholarly research coverage, owing to the increasing environmental issues arising from the emission of CO_2during the production of cement. Over 5% of CO_2 global emissions occur in concrete production with the manufacture of cement being the major contributing factor (Rao et al., 2014; Johnson and Gonzalez, 2013; Gambhir, 2009; Crow, 2008; Mehta, 2001). Nigeria is Sub-Saharan Africa's largest cement producer, while South Africa is the second largest cement producer in Africa. Together they contribute over 29 and 17.5 million tons respectively, to the annual 2.8 billion tons of global cement production (Mapiravana, 2009; Nigerian Cement Industry, 2014).

Ghuge et, al. (2019) implemented the plastic waste in making of paver blocks. It is a very good for environment to use of plastic waste in the paver blocks. They did research of utilizing the plastic bags and waste to recycle in the manner of making paver blocks. They compare the strengths between concrete paver blocks and paver blocks made with plastic waste. In the results the compression test shows that the strength of normal concrete paver blocks having

little more strength than the paver block having plastic waste but also seems to achieve good strength which can be used in some areas. It helps to save the earth from dumping plastic waste.Wang et al. (2021) investigated on copper slag for substitution in concrete. In this research they investigate all of the copper slag properties. Copper slag has uneven shape and looks like dark glassy. Copper slag surface seems to be smoother than the sand hence workability increases but shear strength decreases as well as water absorption and friction decreases too. Bleeding occurs because of addition of copper slag which is not harmful and also not reactive to the materials.

Concrete curing is one of the most important and final steps in concrete production though it is also one of the most neglected and misunderstood procedures. has a major influence on the properties of hardened concrete such as durability, strength, water tightness, wear resistance, volume stability, and resistance to freezing and thawing, creep, chemical attack and density. For curing to be beneficial in concrete it should start as soon as concrete hardens since the detrimental effect of early improper curing are irreversible. American Concrete Institute, (1991).

Concrete curing is a critical step in the durability process used to retain enough moisture and control temperature for promoting the hydration of cement. Curing is the maintenance of a satisfactory moisture content and temperature in concrete for a period of time immediatelyplacing and finishing so that the desired properties may develop during hydration. Curing is frequently used to describe the process by which hydraulic-cement concrete matured, develops hardened property, the maintenance of anacceptable moisture content and temperature in concrete for a period of time immediately placing and finishing so that the desired properties may develop during hydration. In order to attain good quality concrete, a suitable mix must be followed by curing in a suitable environment during the early stages of hardening,(Neville 1981).

Abdalla et al, (2019). The question of the amount of water required to hydrate cement is unrelated to the question of sustained Hydration over time, Anwar et al, (2022). The minimum amount of water required to bring cement to its ultimate degree of hydration (which may not be complete hydration) is, for an average cement, about 0.44 gram of water per gram of cement, plus the curing water that must be added to keep the paste saturated. This amount of water is the minimum that will provide space and only in that part of the water-filled space that is outside the gel-substance, that is, only in the water-filled capillaries in the paste.

The issue of the investigation of the effect of curing conditions on the properties of cementitious systems is one of the important concerns that need to be studied. This paper focus on the efficiency on different curing conditions, agro-waste materials, curing duration and environmental conditions. Therefore, this study was carried out to investigate the effect of optimum effect of various curing condition on the compressive strength of concrete blended with CCA, cost of cure and feasibility.

MATERIALS AND METHODS

Materials

The experimental materials werecarefully monitored for the quality of the various materials consistent;

Coarse aggregates crushed with maximum size of 20mm was used in a saturated surface dry condition based on BS 812 (1996). And the fine aggregate used was also in saturated surface dry condition. The percentage passing 600μm of the fine aggregate, and also conforms withBS 812, (1996). The cement used in the study was Dangote Cement as one of the most widely used cement for construction in Nigeria and conform with BS 812 (1996). The Corncob from maize cob was locally sourced and ashes was used. Portable waterfrom civil engineering laboratory of the federal polytechnic Ado-Ekiti. free from

suspended particles and chemicals was used for both mixing and curing.

Agro-waste Corncob CCA

Corncobs is still a significant component of the maize corn residue. It is estimated that maize cob amount for 40-50% for total corn production. Corncob is considered an agriculture waste (by-product). This causes environmental pollution, which produces health problem.

Corncob used in this research was locally sourced from Ado environ in Ekiti State The corncob was air-dried in the sun for 5days to reduce its moisture content, and were pulverized using a milling machine to reduce the average grain size of the cobs. The ash from Corncob was produced by subjected to a controlled temperature of 550^{0}C usingmuffle kiln for about 3-4hrs per batch to complete the removal of the carbonaceous material until white ash residue was noticed and it was conducted in the department of mechanical engineering laboratory of the federal polytechnic Ado-Ekiti. According to Suwanmaneechot et al. (2015), CCA exhibits more appropriate behaviors of pozzolanic material when calcined at 600°Ctemperature. The chemical analyses of the ash were carried out in multi-use laboratory, Chemistry department, the federal polytechnic Ado-Ekiti to confirm the level of presence of silicon and alumina content.

Experimental Methods

Mix constituents

In the study, mainly two parts of concretes were compared. The first part aimed to evaluate the influence of the type of curing process on the properties of the concrete paving stone. The second part aimed at the determination of the effects of CCA content on the properties of paving stone. The quantities of concrete ingredients were prepared based on water-cement ratio of 0.50 and 75% aggregates content to have a homogeneous mixture of 0, 2.5, 5, 7.5 and 10% replacement of CCA contents as shown in Table 1. Atotal of 40 cubes was design with concrete density of 2400kg/m^3. According to (Neville 2000), the concrete density of normal weight lies within the range of 2200kg/m^3 to 2600kg/m^3. A concrete of grade 20N/mm^{2}at 28days was design and concrete mixtures was cast in cubic moulds of size 150mm^3.

Table 1: The Material Constituents.

Constituents kg Per m^3					
Quantities	0%	2.5%	5%	7.5%	10%
CCA	-1.473	2.946	4.419	5.892	
Cement	58.920	57.447	55.974	54.501	53.028
Sand	88.368	88.368	88.368	88.368	88.368
Crushed granites	176.736	176.736	176.736	176.736	176.736

Experimental Procedures.

Concrete grade M20was produced with standard metallic moulds of size of 150mm^3. A nominalmix proportion of 1:1.5:3 and w/c ratio of 0.50was prepared in batches of 0, 2.5, 5, 7.5 and 10% replacement of CCA. The dry constituents namely the aggregates (sand and crushed stone) and cement were mixed thoroughly, before water was added gradually to achieve a uniform pasteconcrete. The moulds was filledand manually compacted using steel rod at minimum strokes of 25 per layer to expel the entrapped air. The harden concrete wasremoved from the moulds after 24hrs. and cured on four curing conditionsfor prescribed age of7 and 28days.Tests were applied to determine compressive strength using the hydraulic crushingmachine of 1000kN capacity in the department of civil engineering in concrete laboratory of the federal polytechnic Ado Ekiti. The failure load was divided by the cross-sectional area to obtain the strength, which is in accordance with BS EN 1008 method for determination of compressive strength of concrete cubes and recorded.

Specimen Curing

In order to compare the effects of the curing process, the specimens were divided into four sets under the four curing conditionsuntil7 and 28days maturity for testing. The four methods used for curing were spraying, immersion water and air curing and moist covering with sand. In spraying with water method, the specimens were kept moist by intermittent spraying with water three times daily (morning, afternoon and evening) up to thedays of crushing. In immersion in water, the specimens were immersed into water until the days of crushing. In air curing the specimen were left on natural open air to cure for the require ages with ambient air temperature recorded at 27 ± 2°C and relative humidity of 90% ± 1%. Moist covering with sand, the specimens were covered with sand until the days of crushing. The specimens were tested at 7 and 28days of curing maturity.

RESULTS AND DISCUSION

The Oxides Composition of Cement and CCA

The oxides composition of cement and CCA are presented in Table 2.The total composition of (Fe_2O_3=3.02%), (SiO_2=53.60%) and (Al_2O_3=1.42%) was found to be 58.047%.The value shows that CCA possessed pozzolanic characteristics as specified by ASTM C618 (2005). This value is a little more than the value obtained by previous researcher (Kamau et, al2016), in their research on the suitability of CCA as a supplementary cementitious material.

Table 2: Oxides Composition of Cement and CCA

Composition %									
	SiO_2	Al_2O	CaO	Fe_2O_3	MgO	N_2O	K_2O	SO_3	C
CCA	53.60	1.42	3.70	3.02	0.006	0.25	1.12	0.004	46.67
Cement	19.05	4.94	63.58	0.063	1.96	0.75	0.43	0.50	0.00
ASTM C618-12 requirement (SiO_2+Al_2O_3+Fe_2O_3)≥ 70%									

Particles size distribution of aggregates.

Locally obtainable crushed granite and river sand was used as coarse and fine aggregates respectively. Fine aggregate of fineness modulus of sand 2.92 and grade Zone II was used. The Coarse aggregate of nominal size 20mm and fineness modulus of 1.91was used. Table 3 shows the fractions of different sizes of crushed stone and fine aggregates as required to limit specified by IS: 2386-Part 1-1963.

Table 3: Gradation of aggregates

Percent Passing% Sieve sizes (mm)	20	14	10	52.36	1.18	0.6	0.3	0.15	pan
Fine--		100	97.49	90	73.69	34.35	9.85	2.53	0
Coarse		100	65.1	40.9	2.9	-	-	-	-
BS 882-92Limits.		100	95-100	80-100	50-85	25-601	0-302	-10	
		85-	1000	-700	-50	0-5			

Experimental Properties of Concrete Materials.
Table 4, Shows some properties of constituent materials procured from a nearby source was used in this study. The specific gravity conducted on materials shown the specific gravity of CCA as 2.13 compare the value obtained for cement 3.15. This value was relatedto literatures ranging from 1.95 to 2.55 by (Shazim, 2017 and Price et al, 2014). The bulk density of cement of 1422kg/m^3 which is higher compare to that of CCA as 634 kg/m^3 in relate to800kg/m^3 by (Ettu et al. 2013). The recommended value range of 1.9 to 2.4for supplementary pulverized fuel ashes as in ASTM C-218.

Table 4: Some Properties of Concrete Materials Used.

Materials					
Properties					
Sand Granite Cement	**CCA**	**Water**			
Fineness	%2.92	1.91	4.6- -		
Maximum size (mm)	5.0	20 -	- -		
Specific gravity	2.66	2.71	3.15	1.93	1.00
Bulk density (kg/m^3)	15752660	1422634	1000		

Compressive Strength Behaviours.
Assessment of the experimental data, concerning the relation between compressive strength of paving stones after cure and CCA addition are presented in figure 1 and 2shownthe influence of four category of curing conditionson hardened CCA blended concrete for weight replacement of0, 2.5, 5, 7.5 and 10%at 7 and 28dayscuring maturity. It is observed that at 0% CCA had the maximum compressive strength due proportion of cement was the highestand the strength increases with the increase in age of curing conditions. The mixes containing CCA displayeddownward results as the CCA content increases,thus indicate that the optimumreplacement level for Corncob ash is at 5% replacement for all curing conditions at 28days.

The immersion water practicehasthe highest compressive strength23.56N/mm^{2}at 28dayscompared to other curing adopted, this is due to greater degree of cement hydration reaction without any loss of moisture from the concrete cubes. The least compressive strength is recorded for air curing at 20.08N/mm^2. Thestrength requirements in all curing conditions at 28days are in conform to BS EN 12390.

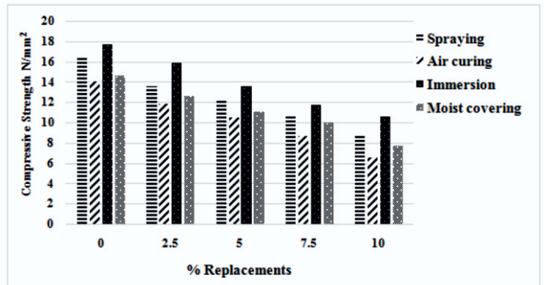


Figure 1: Present the compressive strength at 7days concrete blended with CCAfor four Curing conditions.

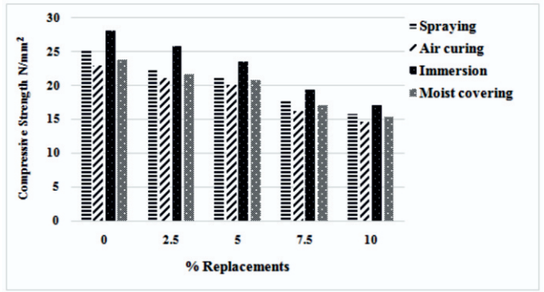


Figure 2: Present thecompressive strength at 28days concrete blended with CCAfor four Curing conditions.

CONCLUSIONS

Base on the experimental test results obtained in the study, the following conclusions can be drawn:

I. CCA is pozzolanic as it has a combined (SiO_2+ Al_2O_3+ Fe_2O_3) lower than 70%. It is classified as a pozzolan in class C according to ASTM C 618.
ii. In overall, Corncob Ash is certainly retaining pozzolanic characteristics and the compressive strength decreased with an increase in CCA. The highest compressive strength values are obtained in 5% CCA content for all the curing process at 28 days.
iii. Reduction in compressive strengths of CCA blended cement concretes as a result of increasing mass replacements of CCA in hardened concrete.
iv. Curing by immersion under water is the best curing practice compared to other approaches, this is because it gives an optimum compressive strength; 23.56N/mm^{2}due to greater degree of cement hydration reaction without any loss of moisture from the concrete specimens.
v. Air curing method produced the lowest level of compressive strength;20.08N/mm^{2}compared to other curing methods adopted due to hydration of cement and reaction were decline.
vi. The use of CCA for concrete production will decrease overall cost of concrete paving stones, durability performance and reduce the quantity of waste in the environment.

RECOMMENDATIONS

I. Further research is recommended that more than 28days curing duration should be the experimented four curing conditions for effective require strength of the paving stone, in some cases.
ii. As a result, to make use of recycled materials to produce eco-friendly concrete paving stone with good quality, it is recommended to prepare the paving stone with 5% recycled CCA with immersion cure process.
iii. Further studies should be carried out on the utilization of other sources and processing of materials to enhance the strength properties of concrete.

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CONTEMPORARY ISSUES IN APPLIED LINGUISTIC RESEARCH

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ABSTRACT

This paper aims at chronicling the milestones or generations the field of Applied Linguistics has undergone so far since its inception in the 1940s. It establishes that in contrast with other well-established disciplines that have spanned for centuries, Applied Linguistics is relatively a young research domain; and that there has been revision of perspectives down through the decades since the discipline was birthed as an independent, but interdisciplinary field— revisions that represent five generations of variegated approaches. Such revisions have been shown to rest on research traditions. The introductory section demonstrates a need for a precise definition of the scope of applied linguistics. The sections that follow trace the origin and history of applied linguistics, focusing on five milestones in professional and scholarly developments, viz.: Structuralism, Transformationalism, Functionalism, Constructivism, and SLA (Second Language Acquisition) Theorizing. The final section presents a conclusion.

***Keywords*:** Applied Linguistics, second language acquisition, linguistics applied, audiolingual method, structuralism, functionalism, transformationalism, constructivism

INTRODUCTION

The phrase 'contemporary issues in … research' in the title of this paper constrains this study to a focus on the research, scholarly or professional tendency that has prevailed in applied linguistics so far following the inception of the discipline, and by the same token, implies that the discipline is likely to trend other research traditions. Hence, we will attempt a historical mapping of those research traditions that have characterized applied linguistics down through the decades of its existence as a discipline.

However, it is usually worth the while in any applied linguistic research to set out a researcher's bias about the notion 'applied linguistics' before delving into work in the field. It is logical to do so, especially when it is understood that there are claims and counter claims in studies on what applied linguistics is and is not. A researcher has to ruffle feathers on

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Applied Linguistics is a nascent disciplinary domain, spanning only for a few decades, unlike fields such as Mathematics and astronomy that have a long, multi-century history. Since the field is young, there has been a need to define and re-define its identity (i.e., scope) while new theoretical developments and empirical findings accrue. This growing revision of the identity of Applied Linguistics creates uncertainty, making the field confusing as to what its research boundaries are, and raising questions as to what the identity of practitioners in the field is. Consequently, Applied Linguistics (henceforth, AL) has been given a wide range of interpretations (Corder, 1973; Widdowson, 1980; Kaplan, 1990; Stevick, 1990; Lightbown & Spada, 1993; Sridhar, 1993; James, 1993; Brumfit, 1995; Masny, 1996; Grabe, 2002; Schmitt & Celce-Murcia, 2002; Davies & Elder, 2004; Wei, 2007). Gunnarsson (2006) believes that the traditional and widespread conceptualization of the term remains the narrowest point of view, which construes AL as 'the application of linguistic research to mother tongue education and to the teaching and learning of foreign and second languages' (p. 1). Agiriga (2014), commenting on this view of AL, considers its implication, thus holds that This Traditional perception of AL delimits It to educational problems, and according to this view, the central issues of AL are language learning and acquisition, error analysis, testing, and teaching methodology and technology— Issues that circumscribe AL within an instructional setting or scope. (p. 7)

This traditional circumscription of AL noted by Gunnarsson has been under attack in the literature by counter views which contend for a Postmodernist perspective, hence, perceiving this view to be too conservative, and thus, not encompassing the growing multi-disciplinary areas of research interests in the field. This contention has forced a polarization of views on what constitutes AL. Exponents of a new view to AL (e.g., Van, Bongaerts, Extra, Van, & Janssen-van, 1984) argue for a more inclusive perception of AL, averring that the discipline has exceeded its inceptional limits given that it is an evolving discipline, and as such has raked in other hitherto excluded areas of research concerns. Hence, they advance a broader interpretation of AL which is widely inclusive, construing AL as not only limited to language education alone, but also covering different areas of language problems in society— practical and social problems of all kinds (Bygate, 2004; Chadlin & Sarangi, 2004). From the standpoint of this broad view of AL, Schmitt and Celce-Murcia (2002) offer one such broad perceptions. According to them, AL is concerned with increasing understanding of the role of language in human affairs and thereby with providing the knowledge necessary for those who are responsible for taking language-related decisions

whether the need for these arises in the classroom, the workplace, the law court, or the laboratory. (p. 1)

This inclusive view of AL has however been under attack in research literature. The thinking is that with such broadening of perspective, practitioners in the field will lack definite knowledge of the precise tasks that make them applied linguists. The delimitation of AL to all language related social problems does not take into consideration the fact that such problems will continue to broaden, and that human language problems are too complex and large to be handled by a single discipline like AL. The implication of this inclusive view of AL is that both the discipline and its practitioners are in a state of flux as human language-related problems broaden and evolve, and as remarked earlier, this has occasioned the question of what the identity of practitioners in the field is, since precision is the hallmark of identification.

This wide-ranging, all-encompassing perception of AL gives the discipline an amoebic shape. Agabaidu (2014), voicing out concern about this, submits that in the revolutionary zeal of making AL more inclusive in orientation, researchers have mapped 'language and cognition' (psycholinguistics), language and society' (sociolinguistics), 'language and writing' (orthography studies), 'language and technology'(as in computer-based Corpus Linguistics) etc onto AL. (p. 8)

An example to illustrate this can be taken from Grabe (2002) who, like numerous other sources (Widdowson 1980, for instance), includes in the realm of applied linguistics language contact problems as well as language use problems such as, for example, dialects and registers. The problem here is that these research areas also belong respectively to contact linguistics and sociolinguistics, much of which is not applied in any sense of the word. The problem with this inclusive perspective to AL is that it does not recognize disciplinary compartmentalization's. It gives AL more problems, more scope, than it can handle as a single discipline. The argument that AL is an evolving discipline is rather taken too far. It is our suggestion, therefore, that those growing areas of interests in language research should constitute fresh sub-linguistic disciplines in their own right. It then follows that the traditional and narrow view of AL is still and should remain a respectable perspective, with its primary and defined concern on 'second language acquisition theory, second language pedagogy and the interface between the two' (Schmitt & Celce-Murcia, 2002, p. 2). In a nutshell, therefore, AL can be interpreted as concerned with language learning and teaching. That language is usually a second language, otherwise called, foreign language.

There has, however, been a remarkable revision on the traditional view. From the seminal view that AL entails the application of linguistic research in language education (be it first or, and especially, second language), the current thinking is that what is applied is internal in AL, and not loanable from linguistics. This revision came in response to the observation that linguistic theories are inadequate in the handling of language problems. In recognition of this insufficiency, researchers such as Widdowson (1979, 1980, 1984) call for the autonomy of AL from linguistic theories, arguing that linguistic models are inadequate for language teaching and that applied linguists should construct models of their own. The argument is that AL is no longer seen as a dependent of linguistics. This is opposed to Corder's (1973) position that linguistics is relevant in providing the applied linguist with detailed descriptions of language. In his call for independence of AL, Widdowson (1980) introduces an important distinction between AL and linguistics applied. What Widdowson calls 'linguistics applied' is, as a matter of fact, the old understanding of AL as the application of findings made in linguistics to language-related, real-

life problems. AL proper, in this view, constructs its own theoretical models, given that models are a distinguishing feature of a separate, independent discipline. In the words of Widdowson, for linguistics applied, therefore, the question of central concern is: how far can existing models of description in linguistics be used to resolve the practical problems of language use we are concerned with. For applied linguistics, the central question is: how can relevant models of language description be devised, what are the factors which will determine their effectiveness. (p. 165)

Other claims of the independence or distinctiveness of AL have been put forward in research literature. Davies and Elder (2004) describe the difference between linguistics and applied linguistics. In their words: While linguistics is primarily concerned with language in itself and with language problems in so far as they provide evidence for better language description or for teaching a linguistic theory, applied linguistics is interested in language problems for what they reveal about the role of language in people's daily lives and whether intervention is either possible or desirable. (pp. 11–12)

In our understanding, Davies and Elder's argument carries the implication that linguistics is basically concerned with language, while AL is concerned with the language user. They are not alone in this position. Wei (2007) takes the same stance as well, remarking that AL is a user-centred or user-friendly linguistics. We find this argument intuitive, and so lend support, given that AL is generally believed to be concerned with language learning (by implication, 'learner language').

From the foregoing, an inference can be drawn of what AL is currently viewed to be, that it is an independent discipline concerned with the application of paradigms (i.e., theoretical models) of language pedagogy (generated, in the main, within the field, and not retrieved from linguistics) that facilitate the acquisition of a second language. This is the mainstream thinking in research literature.

Origin of Applied Linguistics

Evert (2013) makes a claim that modern foreign language teaching began in the second half of the 19th century, when economic and cultural changes led to increase in international trade and provided more travel opportunities, thus raising the awareness of foreign language knowledge as a personal asset. (p. 2)

She, however, admits that there was nothing applied in activities associated with the practice (i.e., language teaching) at the time. Following the birth of foreign modern language teaching, teachers and philologists (e.g., Viëtor, 1882; Sweet, 1899; Jespersen, 1904; cf. Howatt, 1982, 1984) began to publish their recommendations on how best to embark on the enterprise of foreign language teaching. Professionals in modern language teaching did not consider themselves applied linguists, but designated themselves as foreign language teachers. This was well becoming, given that at that time, the main preoccupation was with the history of languages, which had little to offer that could in any sense be deemed applied (Evert, 2013). At the turn of the century, in America, there were already a number of professional associations for foreign language teachers and there were modern language departments at a number of universities (Kayser, 1916).

The advent of Formalism, precisely Structuralism (an analytical and language teaching tool designed for characterizing the syntactic structures of sentences in terms of their grammatical categories and surface arrangements (Hakuta & Cancino, 1977)), in linguistics created a potential for productive interaction between language teaching and linguistics. (According to Fisiak (1984), the first efforts to produce teaching materials based on

structural comparison of two languages were undertaken by Czech authors in the 1920s)). However, as widely reported in the literature (e.g., Evert, 2013), it was World War II that brought the potential to fruition. The United States' entry into World War II and the subsequent Cold War period created a need for effective foreign language instruction for military personnel, hence, the establishment of the first secret US Army foreign language school in 1941 (DLIFLC, 2012), followed by numerous other similar facilities. The military foreign language programmes set up new standards for foreign language teaching by creating what was then colloquially referred to as the 'Army method' (Brown, 1987) and later on as the audiolingual or aural-oral method, a teacher-dominated approach to language teaching (Nunan, 1995) characterized with 'isolated practice in drilling language patterns' (Yule, 1999, p.133). The method, firmly rooted in Behaviourism (Richards & Rodgers, 1995) in psychology and Structuralism in linguistics, was considered the first truly scientific (and hence, applied) language teaching method. Bloomfield's (1933) concept of 'language habit', previously unknown to psychologists, which viewed language learning as learning a set of habits, became the platform on which this method rested. (Other structural approaches to language teaching include: Lado's (1957) **Contrastive Analysis Hypothesis**, which stimulated research in contrastive linguistics with a view to applying the results of these studies to the practical end of preparing teaching materials; the **grammar-translation method**, which entails the learning of grammatical rules of the target language and the presentation of vocabulary in the form of a bilingual list (Krashen, 1995); the **direct method**, also known as 'natural approach' (Askes, 1978), where rules of the target language are learnt inductively, that is, through using the language; and the **oral approach** or **situational language teaching**, which views language as a set of structures related to situations (Rugare & Shumirai, 2012)))). Thus, the field of AL was born, in its first generation espousing the tenets of Behaviourist and Structural linguistics. However, as remarked by Guiora (2005), the very term 'applied linguistics' was probably officially used for the first time in a title of the Language Learning Journal, which was subtitled as A Journal of Applied Linguistics until the 1970s.

Trends/Milestones/Generations of Applied Linguistics

As said elsewhere in this paper, AL is relatively a young discipline of a few decades old. In the words of Weidemann (1998), 'Applied linguistics is a fairly modern phenomenon' (p. 4). Along its historical path, milestones of both theoretical and practical concerns can be established in their successive evolutions, each representing a generation of distinctiveness in both philosophical and practical orientations. In this section, we will attempt to impose some order in the myriad of developments in AL as an effort towards categorization. The outcome of this effort will be a representation of the stages or generations the discipline has undergone since its inception in the 1940's.

In the previous section, it was suggested that the Second World War was the agent of the birth of AL. The war effort required American soldiers to be able to speak the languages of the Pacific or of other places where they were dispatched to make war. Consequently, according to Weidemann (1998), 'some theoretical linguists, who had an intimate knowledge of the structure of especially the indigenous, American Indian languages, took up this concern' (p. 4). Therefrom, AL was birthed, and at this fledgling stage, was concerned with the application of linguistic structural analysis to language teaching. Thus, Structuralism became a foundational theoretical learning base, with

audiolingualism as the touchstone for language teaching which hinged on the Skinnerean learning approach (i.e., Behaviourism) (Richards & Rodgers, 1995; Weidemann, 1998). Audiolingual method majored on pattern practice, that is, it held that the more a learner repeated patterns of the target language, the more likely he would remember and acquire the language. The approach was fraught with the assumption that learning takes place incrementally, in small portions (Weidemann, 1998). Because audiolingualism borrowed from the academic psychology of learning (Behaviourism), and hence, viewed language as habit formation, learning activities in this method included memorization of structure-based dialogues, repetition, substitution, transformation and translation drills. In short, learning under this method was by rote. Rooted in Behaviourist psychology, the method did not recognize the cognitive power of the mind in learning, since Behaviourism, according to Rotfeld (2007), provided a method 'that would allow control and measurement of all relevant variables by ignoring human thought or cognition' (p. 376). The major proponent of the Behaviourist school after Watson, Skinner himself, as reported in Gregory (1987), stated that the mind and mental processes are mere "metaphors and fictions," and that "behavior" is a function of the "biology" of the organism. He expressed no interest in understanding how the human mind functioned, because of his belief that thoughts, feelings, intentions, mental processes, and so forth have no bearing on what humans do, but their environmental experiences. Learning was viewed as mindless response to stimulus through conditioning occasioned by 'mechanized' rote learning. Therefore, audiolingualism on which this theory was based, approached instructed foreign language in points of views that drew on Behaviourist thought. One feature of the method, according to Richards and Rodgers (1995), was non-contextualization of the chunks of language taught as evident in methods based on the communicative approach. Remarking on this feature, Yule (1999), observes that 'apart from the boredom associated with the method, its other major weakness is that…isolated practice in drilling language patterns bears no resemblance to the interactional nature of actual language use' (p. 133). Furthermore, emphasis was on linguistic competence, as opposed to Hymes' (1962, 1964, 1972) notion of communicative competence that was yet to make its entry in language learning methodology. In addition, accuracy was held in primacy, as production was 'expected to be error free' (Krashen, 1995, p.129). Thus, error came to be seen as a bad egg that must be eradicated by punishment; and as an evidence of inoperative teaching method and imperfect learning. The method, far from being a parody of naturalist learning, was mechanical. It was teacher-dominated (Nunan, 1995) through the use of fronted classroom.

At its inceptive phase, AL was indebted to linguistic theory. Put precisely, practitioners in the field where applying linguistics in the defined goal of developing mastery of foreign languages in learners.

That the Behaviourist-Structural approach to language teaching saw language merely as an environmental input, a conditioning stimulus capable of establishing itself as habit in a language learner, without accommodating within its sphere of concern the cognitive aspect of learning, soon made the approach fall out of repute by the formulation in the late 50's of a linguistic theory that soon transformed into a movement, known as 'Transformationalism'. The theory was the Transformational Generative Grammar, credited to the American linguist, Chomsky (1957). This marked the second generation of AL with its recognition of cognition in language learning. Although Chomsky's theory was psychological as was its predecessor, Behaviourism, it was rather based on a mentalist (i.e., competence, by extension, 'knowledge'), as opposed to a

behavioral (i.e., performance), view of language learning. And again, although its major concern was a delineation of how children acquire their mother-tongue, his cognitive view of language learning brought a lot of insights into how foreign or second languages are acquired; led to serious research in second language acquisition (SLA), thus, SLA came to be seen as a special object of inquiry in the late 60's (Larsen-Freeman & Long, 1991; Cook, 1993; Ellis, 1994; Gass & Selinker, 2008; Ortega, 2009), with the extension of Chomsky's notion of language cognition into second language research. His argument was that all about language learning did not constitute in environmental input (which would pass as 'stimulus' in Behaviourism), and that the human mind (i.e., a child's) has a natural tendency to generate language— novel sentences that are independent of learning, but innate. The argument made a sensational impact in second language acquisition research. Researchers in the field began to rethink the acquisition processes involved in learning a language using a set of powerful transformation rules formulated in the theory. Under the influence of the Chomskyan thought that a child's grammar demonstrates an independent, evolving rule system in its own right, researchers in second language acquisition began to view learners' developing language as a linguistic system in its own right that should be studied on its own, and not as a deviation from some perfect form of language. Selinker (1972) would eventually conceptualize this independent linguistic system as 'interlanguage'. (An interlanguage incorporates characteristics of both the native and the target language of the learner). This view revised the attitude towards learner errors. Rather than being seen as products of imperfect learning, as held by the Behaviourists, learner errors came to be regarded as inevitable results of an underlying, rule-governed system which evolved toward the full native-speaker grammar. Under the impetus of Chomsky's breakthrough in the inquiry on how languages are learnt by children, many investigators (e.g., Corder, 1967; Dulay & Burt, 1972; Richards, 1973) noted similarities between the types of errors reported in the first language acquisition literature and the errors made by second language learners. These errors could not be accounted for within the contrastive analysis framework. On the basis of this similarity, researchers speculated that the processes of first and second language acquisition are essentially the same. Like children learning their first language, second language learners were characterized as proceeding through a series of intermediate grammars (Corder, 1971; Nemser, 1971; Selinker, 1972). At any given time a learner was credited with having an 'interlanguage,' a genuine language in the sense that it consists of a set of systematic rules that can be described in a grammar. This cognitive view of language learning by Chomsky shifted concern to the acquisition of linguistic knowledge and internal mental structures of students' learning processes and to the issues of how information is received, organized, stored, and retrieved by the mind. According to Merrill, Kowalis and Wilson (1981), this shift from a behavioral orientation (where the emphasis was on promoting a learner's overt performance by the manipulation of stimulus material) to a cognitive orientation (where the emphasis was on promoting a learner's mental processing) also created a similar shift from procedures for manipulating the materials to be presented by an instructional system to procedures for directing learner processing and interaction with the instructional design system.

Although Transformationalism drew massive following and created a milestone in AL's development, in that it gave serious theoretical and practical bearing to second language research, the movement was fraught with shortcomings. In the first

place, its Structuralist, non-contextualized description of language came under suspicion. It was purely linguistic, and implied a teaching method that focused on inculcating grammatical competence on learners insensitive to the sociolinguistic or contextual functions of language. Focus was on the form as opposed to the function of language in a social setting. This lapse created an agitation among second language researchers (e.g., Campbell & Wales, 1970) prominent among whom was Hymes (1962, 1964, 1971), who contended that context should be taken into accounting in any language description and learning situation with his famous notion of 'communicative competence'. Hymes conceived 'communicative competence' as not only comprising the ability to produce well-formed, grammatically correct sentences, but also the ability to match linguistic knowledge with situational contexts. He conceded to Chomsky's (1965) notion of linguistic competence as enshrined in the transformational generative theory, but added that grammatical competence should involve knowledge of how to apply the competence in a variety of communicative situations. Thus, he brought the sociolinguistic perspective into Chomsky's linguistic view of competence. This inaugurated an era of AL where emphasis was placed on the functional use of language in situational contexts. Angling his proposal from the point of view of the native speaker of a language, he contended that other than linguistic competence, the native speaker has another rule system without which the rules of grammar will be useless; that the native speaker knows intuitively what is socially appropriate or inappropriate and can adjust his language use to such factors as the topic, situation and human relations. The pedagogical impact of this development was the birth of the communicative language teaching approach with its emphasis on the functional or pragmatic use of language in context. Functionalism argued for a style of pedagogy where immersive exposure to the target language would be the order, and where fluency would supersede accuracy in pedagogical concerns.

Functionalism did not bring about a halt on Transformationalism, but rather expanded its applicability to language description and learning. From the late 60's, the functionalist outlook dominated, with the communicative language teaching tooled to drive its tenets in the language classroom. But as observed by Weidemann (1998), there was obviously something missing. For example, what was missing - at least initially - in the communicative approach, was a theory of

language learning…While many could readily agree that not the forms of language but also its functions were important considerations in designing language courses, how students would actually learn better was not clear at the inception of communicative teaching.

At the wake of Hymes' suggestion for a communicative approach, there was no theoretical base to translate his proposal into classroom practice. Although the communicative approaches in pedagogy employed 'notions' and 'functions', and hence, **notional syllabus or notional-functional syllabus (**which is based on the general concepts and contents that a learner will need to express**)** for general language competence development in learners; and **needs analysis-based course design (**which specifically deals with the area of language use that a learner will need to gain competence and the extent of attainment in such competence) for restricted competence development, however, as a theory, Communicative Competence was deficient in itself in accounting for the pedagogical applicability of its claims. Pedagogues experimented with various instructional designs in a bid to bring home the tenets of this theory to the classroom.

From the 80's, research in AL began to tap its roots in constructivist psychology towards not only clarifying the processes by which a learner develops

linguistic knowledge, but also mapping out more effective classroom practice in second language learning. Constructivism was formulated through the works of Piaget, Bruner, and Goodman (Perkins, 1991). It is a theory that equates learning with creating meaning from experience. Although constructivism is considered a branch of cognitivism in that both conceive learning as a mental activity, it essentially differs from traditional cognitive theories: Most cognitive psychologists think of the mind as a reference tool to the real world; constructivists believe that the mind filters input from the world to produce its own unique reality (Jonassen, 1991). Constructivist applied linguists averred that learners develop knowledge of a second language through experience (Clancey, 1986). Under this theory, the belief was that learners *create* meanings as opposed to *acquiring* it, and that learners do not transfer knowledge from the external world into their memories; rather, they build personal interpretations of the world based on individual experiences and contextual interactions with the external world (and in this case, language). Constructivists emphasized learners' flexible use of pre-existing knowledge (i.e., experience) to filter pre-packaged incoming information, and their construction of meaning thereby. Translating this into actual classroom practice, constructivist classroom practitioners recognized individual learner's uniqueness in both learning styles and strategies, and structured instructional designs to accommodate learner differences in learning. Since experience is context-based, task-engagements methods were employed in such a manner that reoccurrence of same tasks in similar environment (i.e., context) provided basis for experiential learning. Based on repeated tasks, learners are able to construct knowledge. An essential notion in the constructivist view was that learning always takes place in a context and that the context forms an inexorable link with the knowledge embedded in it. Therefore, according to Ertmer and Newby (2013), 'the goal of instruction under constructivism was to accurately portray tasks, not to define the structure of learning required to achieve a task' (p. 57). The ultimate measure of learning in constructivism was based on how effective the learner's knowledge structure is in facilitating thinking and performance in the contexts in which those tasks were used. Learners were encouraged to construct their own understandings and then to validate them, through social negotiation or interactions. In the words of Ertmer and Newby (2013), some of the specific strategies utilized by constructivists include: situating tasks in real world contexts, use of cognitive apprenticeships (modeling and coaching a student toward expert performance), presentation of multiple perspectives (collaborative learning to develop and share alternative views), social negotiation (debate, discussion, evidence-giving), use of examples as real “slices of life,” reflective awareness, and providing considerable guidance on the use of constructive processes. (p. 58)

With the growing recognition of Second Language Acquisition as the object of enquiry in AL and the proposed separation of AL from 'linguistics applied' owing to the supposed inadequacy of linguistic theories in accounting for many language related issues, there has been a strong preoccupation in theorization of second language acquisition among researchers. (Those working in the field have begun to borrow from other disciplines: pedagogy, psychology and especially that branch of the latter that deals with learning theory —Weidemann, 1998). Many of such theories link up with insights from other disciplines other than linguistics. This endeavour is motivated by two factors, viz.: to further knowledge on how second languages are learnt and to provide pedagogical paradigms to facilitate second language learning. Thus, this generation of AL has

become a multi-disciplinary enterprise. This is the current situation in AL, and it is easy to predict that with a consequent deluge of theoretical models, research in AL will develop other ideological directions.

CONCLUSION

We have attempted here to trace the development of applied linguistics from its humble beginning to the current practice in the field. We have considered the development in terms of trends, milestones or generation, chronicling the emergence of the trends and the motivations surrounding that. It is pertinent to note that any similar endeavour at tracing the trends in applied linguistics will likely toe a different direction because of differences in opinions and the complicated historical mixes of theories and practices in the field that pose difficulty for the neat, crystalized separation of movements, theories and practices.

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CYBER WARFARE AND INTERNATIONAL HUMANITARIAN LAW.

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ABSTRACT

With the rapid advancement in communication technology, there has been an increase in computer-related attacks aimed at both hardware and software of countries computer systems. Some of these attacks are private actors working for their own goals, but other attacks are committed by nations seeking to exploit weakness in their adversaries' computer technology systems. Despite more frequent occurrences of these cyber-attacks, the international community is yet to adopt a framework to govern the rules which nations are to follow in this new phase of warfare. This work describes what cyber warfare is and the applicability of IHL to cyber warfare and some of the challenges faced in this applicability.

It is recommended that new laws should be introduced that deal directly with cyber-warfare as there persists certain complications with the applicability of the three cardinal principles of IHL during cyber-operations. This research adopts the doctrinal research methodology

Key words: cyber-warfare, hardware, software, cyber-attack

INTRODUCTION

Wars have been fought on land, sea, air and now in cyberspace. Recently, many States and non-State actors have started engaging in more advanced techniques of launching attacks while relying on digital infrastructure. Cyber warfare is a relatively new domain in which attacks are being launched and there is a need to explore how this area is governed by international law. Currently, there is no treaty that deals specifically with the development and use of cyber warfare, however the Tallinn Manual, which is a non-binding document, explores the applicability of international humanitarian law ("IHL") to cyber operations and how they are to be applied. However, there remain several issues within the legal framework suggested which require further clarification, this may even take the form of future state practice in this field. This paper will consider the application of IHL during cyber operations, and the challenges associated with it. It will analyze how IHL regulates cyber operations during an armed conflict and will assess the gaps in the current legal regime.

The article will also seek to provide recommendations on how to regulate cyber operations during armed conflicts.

DEFINITION OF TERM

Cyber warfare refers to the "*means and methods of warfare that consist of cyber operations amounting to, or conducted in the context of, an armed conflict, within the meaning of International Humanitarian Law.*"

Cyber warfare is also defined as a cyber-attack or series of attacks that target a country. It has the potential to wreak havoc on government and civilian infrastructure and disrupt critical systems, resulting in damage to the state and even loss of life.

Cyber warfare can also be defined as the use of cyber-attacks against an enemy state, causing comparable harm to actual warfare and or disrupting vital computer systems

Cyber warfare usually involves a non-state perpetrating cyber-attacks on another but in some cases, the attacks are carried out by terrorist organizations or non-state actors seeking to further the goal of a hostile nation, there are several examples of alleged cyber warfare in recent history but there is no universal, formal definition foe how a cyber-attack may constitute an act of war,

Cyber-attacks may involve destroying financial records, causing cyber blackouts, disrupting stock markets, etc. These attacks can be lethal as well, when for instance, blackout in the air traffic control leads to airplane crash. The first ever cyber-attack was reported in 2007 when riots were enabled through social media by Russia in Estonia. This social media campaign led to the shutting down of Estonia's private and government systems. There have been many similar instances where computer data of government systems and other private entities was hacked by State and non-State actors, which led to a blatant violation of the laws of warfare.

APPLICABILITY OF INTERNATIONAL HUMANITERIAN LAW TO CYBER WARFARE AND ITS CHALLENGES

The current IHL regime does not specifically address cyber weapons in the way it has banned certain conventional weapons,biological weaponsand chemical weapons. However, IHL is an adaptive body of law, which can be deduced from Article 36 of Additional Protocol I to the Geneva Conventions ("API"). This provision, also known as the 'weapons review' clause, requires States to conduct a legal review of a new weapon, means or method of warfare to determine if its employment would be prohibited under international law. It is clear from Article 36 that IHL is not restricted to weapons that were developed at the time when these laws were made. Hence, new and emerging technologies are also bound by the

regime regardless of whether they have been directly addressed in the provisions of law or not. So when States adopt IHL treaties, they agree for these treaties to regulate their present and future conflicts. The International Court of Justice's ("ICJ") Advisory Opinion on the *Legality of the Threat or Use of Nuclear Weapons* supports this notion, where the court affirmed that the rules and principles of IHL apply to "*all forms of warfare and to all kinds of weapons, including those of the future*". Therefore, as a new means and method of warfare, States are required to conduct a legal review of all "cyber weapons" to ensure compliance with IHL before using them in operations.

It is essential to establish the applicability of IHL to cyber operations as this regime accords various obligations as well as protections during armed conflicts. IHL is only applicable to cyber operations which occur during or in connection with an armed conflict. These conflicts are categorized into international armed conflicts ("IAC") or non-international armed conflicts ("NIAC"). The category of armed conflict determines the rules applicable under IHL, therefore, it is necessary to consider what elements are required for each to determine which rules apply. Moreover, when it comes to cyber operations there are various challenges in determining when either an IAC or a NIAC exists with respect to the application of IHL.

INTERNATIONAL ARMED CONFLICT

According to Common Article 2 to the Geneva Conventions of 1949, "*the present Convention shall apply to all cases of declared war or of any other armed conflict which may arise between two or more of the High Contracting Parties, even if the state of war is not recognized by one of them*." The Commentary of the Geneva Conventions of 1949 further elaborates that whenever there is a resort to hostile armed force between two states, there is an international armed conflict. However brief or intense this resort to armed forces between States is, it would trigger the application of IHL. Moreover, the law has not prescribed any specific form for the resort to force, therefore hostilities between States may involve cyber operations or any combination of both cyber and kinetic operations. The issue arises when operations by non-state actors or private individuals can be attributed to a State which would render the conflict international. During cyber operations, States often act through private entities in order to preclude direct responsibility. In such situations it is crucial to establish "effective control" of the State over the cyber operation. Therefore, whenever two or more States are involved, having "effective control" over such entities, it would amount to an IAC, and thus the protections and obligations provided under the Geneva Conventions would be applicable. Such control is more difficult to establish in cyberspace as the location of the perpetrators or the machine from which the attack is launched all may be in different jurisdictions, with responsibility all the harder to establish.

NON-INTERNATIONAL ARMED CONFLICT

When it comes to a NIAC, the following criteria needs to be satisfied as entailed in the *Tadic case* whereby i) the hostilities must reach a minimum level of intensity; and ii) non-governmental groups involved in the conflict must possess a sufficient level of organization.

It appears that no cyber-attack by a non-State actor has ever risen to meet the required intensity of violence to trigger a NIAC. Singular and isolated cyber-attacks such as data deft, network intrusions would not launch a NIAC as the requisite threshold of "protracted armed violence" would not be satisfied in such attacks. However, they may occur once a NIAC is already established when they would be part of the hostilities. Another element that needs to be fulfilled

is that a NIAC can exist only between parties that are sufficiently "organized" and have the capacity to sustain military operations. For this reason, there must be a distinct armed group with a visible and verifiable organizational structure. This is difficult in cyber operations which may be conducted through a disorganized group of hackers with little coordination or cooperation with each other.

Regulation of 'Cyber-Attacks' under IHL

As discussed earlier, IHL is applicable to cyber operations that take place during armed conflicts, this section will now delve into how IHL regulates cyber operations to ensure that there is no violation of international law. IHL consists of a set of rules and principles, in light of which, various protections are available during armed conflicts. According to the criteria described above to qualify for an armed conflict, either of an international or non-international nature, there must be an attack. Article 49 of API defines 'attacks' as "*acts of violence against adversary, whether in offence or defense*". According to the Tallinn Manual, a cyber-attack is a "*cyber operation, whether offensive or defensive, that is reasonably expected to cause injury or death to persons or damage or destruction to objects*". There is a general notion that an attack consists of some form of physical damage, however in cyber operations the rights of others may be violated without causing any physical damage. Would this amount to an 'attack' in its true sense? According to the ICRC, an operation that leads to disabling a computer or a computer network would constitute an 'attack' within the ambit of IHL. Therefore, destruction caused by cyber operations would amount to an 'attack' and enable the applicability of IHL on cyber operations. However, some argue that there must be extinguished or reduced functionality due to such an operation for it to amount to an 'attack'. For instance, the temporary disruption of functionality of cyber infrastructure can lead to death, injury, destruction or damage, such as leading to the crash of an aircraft. As it stands, there is not yet consensus as to whether an attack entails injury, death, damage or destruction or whether the broad approach requiring a loss of functionality would suffice.

CYBER WARFARE AND THE THREE PRINCIPLES OF IHL

The reason why the definition of an 'attack' is so important is because IHL's cardinal principles, of distinction, proportionality and precaution, all hinge on their being an established 'attack'. These core principles are discussed below:

Principle of Distinction

One of the most important principles of IHL is the principle of distinction which aims to reduce human suffering and protect civilians during armed conflicts. This protection has been codified in Article 48 of API whereby distinction must be created between civilian objects and military objectives. Only military objectives can be targeted during an armed conflict, and the deliberate targeting of civilian objects is a violation of IHL which amounts to a war crime. The customary definition of military objectives can be found in Article 52(2) of API whereby "*military objectives are limited to those objects which by their nature, location, purpose or use make an effective contribution to military action and whose total or partial destruction, capture or neutralization, in the circumstances ruling at the time, offers a definite military advantage*".

While the rules of IHL apply to both kinetic and cyber operations, however the application of such rules during cyber operations can be tricky because such rules were made keeping physical/ kinetic operations in mind so it is not always clear how these rules would apply to cyber operations. For instance, in this case,

would data qualify as a military objective or civilian object under IHL? Two main views have emerged with respect to this. According to some experts, the definition of an 'object' can only be limited to physical properties i.e. something that is visible and tangible. They believe that IHL rules would not be applicable on cyber operations unless it involves some form of physical effect and/ or a loss of functionality of the target system or network. Whereas, other experts are of the view that data can be defined as an 'object' as data is susceptible to being attacked and destroyed. Consequently, when States or non-State actors hack into essential civilian data during an armed conflict such as medical data, biometric data, social security data, tax records, bank accounts, companies' client files or election lists and records, it could be considered a violation of the principle of distinction.

Another major challenge with respect to the distinction between civilian objects and military objectives is regarding the classification of civilian data as a 'civilian object'. While the laws of armed conflict have defined civilian objects and military objectives, it is unclear whether 'civilian data' such as medical data, biometric data, tax records, social security data etc. would be considered as 'civilian object' in the context of cyber operations. Traditionally, data is not considered an 'object'. The Tallinn Manual reached this conclusion by viewing data as 'intangible' and thus outside the ordinary meaning of 'object'. However, an attack would still be deemed to be launched when due to targeting of data, the functionality of the other State's computers or cyber systems is disrupted.

Principle of Military Necessity and Proportionality

While States and non-State actors must not target civilians and civilian objects during an armed conflict, however if they are made a subject of an attack then the principle of military necessity and proportionality must be respected. Under Article 51(5)(b) and 57(2)(iii), the collateral damage to civilian objects should not be in excess to the concrete and direct military advantage gained from an attack on a military objective. It can be said that proportionality restricts the employment of force through warfare as the principle of proportionality requires that the "*loss of life and damage to property incidental to attacks must not be excessive in relation to the concrete and direct military advantage expected to be gained*". With the growing use of cyber-attacks, it is important to determine when these attacks become disproportionate to civilians. Proportionality, in simple terms, can be defined as a restraint on force. Therefore, it is vital to exercise proportionality when launching cyber-attacks in order to ensure that the attack launched is within the realms of IHL and does not exceed such limitations.

The principle of proportionality is also applicable to cyber operations. While the Tallinn Manual affirms that the law of armed conflict applies to cyber operations, which is why the standard of proportionality also needs to be maintained, the issue with applying this principle to cyber operations persists. Nowadays, there are systems with dual-use i.e., such systems can be put to both military and civilian use simultaneously. Such systems include power plants that supply power to both civilian and military areas, and air traffic control systems supporting both civilian and military bases. The application of the standard of proportionality to cyber warfare would require for there to be a distinction between dual-systems. While dual-use systems can be considered as military targets, however, civilian usage of such systems complicates the applicability of the proportionality standards. Attacking dual-systems would lead to collateral damage.

Another issue that persists with the application of proportionality during cyber operations is the 'knock-on effects', which can be defined as '*the indirect*

consequences that flow from the direct results of a given action'. While it is responsibility of the commander to keep in mind the 'direct effects' which can be defined as '*immediate, first order consequences, unaltered by intervening events or mechanisms'*, it becomes difficult to consider the 'indirect effects' which are '*the delayed and/or displaced second or third and higher order consequences of actions created through intermediate events or mechanisms*'. Due to the expansive nature of cyberspace, it becomes difficult to ascertain the ripple effect of such attacks and determine how such attacks can affect those who are outside the initial sphere of attack. Moreover, the interconnectedness of cyber systems further complicates the predictability of knock-on effects.

Principle of Precautions in Attack

The principle of precautions in an attack has been enunciated in Article 57 of API and is customary and therefore binding on States in both an IAC and NIAC. The principle of precautions in attack can be categorized into active and passive precautions. Active precaution means the steps taken before an attack is launched. These preventive steps aid in identifying targets to ensure that no civilian or civilian object is targeted during these cyber operations. Whereas, passive precaution are the steps that must be taken after a cyber-attack has been launched whereby parties to the conflict are under an obligation to protect civilians from the dangers of these cyber-attacks. Therefore, during a cyber-operation, commanders and all other persons in charge must comply with this legal obligation.

This principle requires the commander to take 'feasible' actions in an attack which means that the commander should consider anything that is '*practicable or practically possible, taking into account all circumstances ruling at the time*'. Before a cyber-operation, the commander would be required to take 'feasible precautions' whereby the commander should determine the effects of the attack on the civilians and civilian objects in the exercise of his constant carry. However, if the commander is unable to determine the attack's extent, he cannot launch the attack. Moreover, the application of this principle is limited to the circumstances of the commander at that time which can easily lead to complications at a later stage. For instance, if prior to the attack the commander has determined that the attack would not cause damage to civilians or civilian objects but later the malware may spread to a civilian network that the commander was not aware of earlier. It is pertinent to note that this principle originated with a 'geographic' focus which makes it difficult to apply to cyber operations especially since these often occur at a speed of milliseconds.

ATTRIBUTION OF CONDUCT IN THE CYBERSPACE

While it is easy to identify the perpetrators of kinetic warfare, the same is not easy in cyberspace. Nowadays, due to the advancement of technology, anyone around the globe can engage in cybercrimes while hiding their identities by using proxies, thus making it almost impossible to assign responsibility to States for this conduct. The attribution of cyber operations is crucial to make sure that actors who violate IHL are held accountable. Under international law, States are held responsible for conducts that are attributable to them. According to the Draft Articles for Responsibility of States for Internationally Wrongful Acts, 2001 the conduct of the following are attributable to the State for which it will be held accountable under IHL:

- State organs;
- Persons or entities upon which the State exercises governmental authority;
- Persons or groups acting under the State's control; and
- Private persons or groups whose conduct the State adopts as its own.

Therefore, attacks launched in cyberspace against another state by government organs, private companies, or persons, whose conduct the State adopts as its own or upon whom the State exercises its control or power would be attributable to the State itself, and the State would be held accountable for the violations of international law through such cyber operations. However, there are major challenges with this approach. It becomes extremely difficult to accord attribution to cybercrimes as attackers deliberately hide their identities and stage their attacks which makes it difficult to find out who caused the attack. Consequently, it becomes incredibly difficult to establish the chain of command and hold any State responsible for cyber-attacks upon another State. However, it may be possible through evidence of where the machine launching the attack is located or through human intelligence which could provide the perpetrator's identity. Therefore, attribution may not be impossible in all circumstances.

RECOMMENDATIONS

As discussed, IHL is applicable to new means and methods of warfare, thus these sets of rules would be applicable to cyber warfare during both IAC and NIAC. Keeping in mind the laws of armed conflict, it is essential to respect the three core principles of IHL i.e. the principles of distinction, proportionality and precaution in an attack. However, when the laws of armed conflict were made, such advanced technologies were not in place, which is why it is the need of the hour to introduce new laws that deal directly with cyber warfare as there persists certain complications with the applicability of the three cardinal principles of IHL during cyber operations.

While IHL is applicable to cyber warfare, its scope is very limited whereby the current IHL regime only requires a legal review to be conducted of such weapons and requires for these 'new means and methods of warfare' to be in compliance with the three cardinal principles of IHL i.e. principle of distinction, proportionality and precautions in attack, the law does not focus on other areas, such as attribution of cyber-attacks. In addition to this, the current war law regime protects civilians and civilian objects from atrocities during armed conflicts, however the same becomes ambiguous when it comes to cyber operations as military and civilian cyber infrastructure are interlinked with each other which makes it difficult to accord protection to civilian cyber infrastructure. Hence, there is a need to introduce a special treaty that deals with cyber warfare in detail while focusing on the findings of the Tallinn Manual regarding the analysis and applicability of IHL on cyber warfare for the purposes of improving cyber security.

Furthermore, focusing on the limitation of the applicability of the principle of proportionality during cyber operations, it is crucial to develop a proportionality standard in a unified international treaty that needs to be observed by parties to a cyber-operation in order to avoid lethal cyber consequences. Militaries need to conduct a proportionality analysis before any cyber-attack that may cause incidental damage to civilians or civilian objections. Moreover, militaries must exercise the 'constant care standard' as stipulated in the API when conducting cyber operations even when these operations are not categorized as 'attacks' to protect civilians and civilian infrastructure. Militaries should also consult cyber experts to be aware of the impact of their attacks or operations on a particular system. This will help them determine the level or degree of anticipated harm incidental to the life of civilians or civilian objects. Moreover, nations should take precautionary measures such as providing systems