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EFFECT OF FERMENTATION ON THE NUTRITIONAL COMPOSITION OF CORN VARIETIES FOR INCLUSION INTO ENTREPRENEURIAL BIOLOGY IN MANGU LGA OF PLATEAU STATE

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ABSTRACT

Maize (*Zea mays*) is the third most important cereal crop in the world and one of the most staple foods in the Northern Nigeria especially Plateau State**.** This study investigates the Effect of Fermentation on the Nutritional Composition of Corn Varieties for Inclusion into Entrepreneurial Biology in Mangu LGA of Plateau State. A laboratory-based Experimental research design was used. A Total of 1kg maize (Corn) varieties (white maize and pop-corn) were randomly purchased, sorted, washed, sun-dried for two days, packed, labelled and stored in air-tight container and taken to the Biochemistry Division of the National Veterinary Institute (NVRI), Vom, for Fermentation and analysis. A total number of 100 well-structured questionnaires were administered to the Respondents. Result shows a statistically significant difference ($p<0.001$) on the analyses of the Respondent's response on the effect of fermentation on nutritional composition of corn varieties **(**F-value = 28.06, Fcrit(2,12)=3.89 at $\alpha=0.05$ level. Analyses of the factors that improves the nutritional compositions of corn varieties **(**F-value = 20.39, Fcrit(2,12)=3.89 at the $\alpha=0.05$ level) shows that the result is statistically significant $p<0.001$). The comparative proximate analysis revealed that white corn has a statistically ($p<0.05$) higher moisture content 11.11±0.51 than pop-corn (6.48±0. 03). The crude protein content of pop-corn (7.47±0. 02) is statistically ($p<0.05$) higher than that of the white corn (6.79±0. 01). White corn has a statistically ($p<0.05$) high index dietary fiber with a value of 23.79±0. 02, more than the Pop-corn with a dietary fiber index value of 22.58±0. 07. White corn has a statistically ($p<0.05$) higher value of Lipids (9.51±0.05), Ash (4.94±0.05), more than Pop-corn having a Lipids value of (4.35±0.15), and Ash (4.58±0.01). On the Nitrogen free extract (NFE), White corn possesses statistically ($p<0.05$) Higher NFE content with a value of 62.74±0.01 compared to pop-corn, with a value 61.55±0. 01. Conclusively, White corn is more nutritious than the Pop-corn, indicating that White corn has more nutritious carbohydrate that provide sufficient amount of nutrients and energy needed for normal body growth, function, maintenance and reproduction. It is recommended that available resources and financial support should be provided by the government to farmers for the production of White corn. Also, government and other non-governmental agencies (NGOs) should create more public awareness on the nutritional value of White corn via symposiums, social media, seminars etc.

Keywords: Fermentation, Nutritional composition, Entrepreneurial biology, Corn variety, Mangu

1.0 INTRODUCTION

Cereal grains are the seeds of grasses in members of the monocot families poaceae or graminae, cultivated primarily for human consumption and animal feed, which composed of the endosperm, germ and bran. Cereals constitute the major sources of energy, protein, vitamins and minerals for the world population (Fawole *et al*., 2018). According to Gautam *et al.* (2019), cereals grains of economic importance include; Maize, Millet, Sorghum, Maize, Wheat, Barley, Oats, and Rice. Maize (*Zea mays*) is the third most important cereal crop in the world (Adebayo *et al*., 2018) and one of the most staple foods in the Northern Nigeria especially Plateau State. Nigeria is one of the largest maize producing countries in Africa (Adebayo *et al*., 2018).

Since its domestication some 9,000 years ago, maize (*Zea mays* L.; corn) has played an increasing and diverse role in global agri-food systems (Erenstein *et al.,* 2022). Maize grains have a high nutritional value and a complex chemical composition. Maize flour is nutritious, tasty, easy to digest, regularly consumed, helps cleanse the colon, helps digestion by reducing stomach acid, consumed as popcorn helps avoid constipation and consumed alongside the rest of the grains helps to reduce the development of certain cancers (Akinyemi

et al., 2019). It also contains booster of antioxidants that protect from various degenerative diseases. Maize is also used in supplementary nutrition programmes and integrated child development services programmes to feed malnourished children and to improve their health status (Akinyemi *et al*., 2019). Nutritional quality of maize also depends on the processing method used. *Zea Mays* is a major cereal crop for both livestock feeds and human nutrition. Maize provides more carbohydrate than wheat and sorghum. The quality of maize protein is primarily a function of its essential amino acid composition. Common maize grains are low in protein, as its protein is deficient in two amino acids (lysine and tryptophan) which are essential for human (Akinyemi *et al*., 2019). It is a good source of phosphorus, and contains small amount of calcium, iron, thiamine and niacin.

Fermentation is one of the oldest biotechnologies for the production of food products with desirable properties such as extended shelf-life and good organoleptic properties (Smid and Hugenholtz, 2010). Finished fermented foods usually have an improved microbial stability and safety and some can be stored even at ambient temperatures. Furthermore, there are several examples of fermentation processes which lead to an increase in nutritional value or digestibility (Jägerstad *et al*., 2015) of food raw materials. Finally, food fermentation processes also deliver products with increased palatability for consumers. All these arguments have boosted the interest to explore natural food fermentation processes and more precisely to link the diversity of the community of fermenting microbes and their properties to the energetics of the process and to product quality. From a biochemical point of view, fermentation is a metabolic process of deriving energy from organic compounds without the involvement of an exogenous oxidizing agent. Fermentation plays different roles in food processing. Major roles attributed to fermentation are: (1) Preservation of food through formation of inhibitory metabolites such as organic acid (lactic acid, acetic acid, formic acid, and propionic acid), ethanol, carbon dioxide, diacetyl, reutrin, bacteriocins, etc., often in combination with decrease of water activity (by drying or use of salt) (Gaggia *et al*., 2011); (2) improving food safety through inhibition of pathogens or removal of toxic compounds (Silva *et al*., 2012); (3) improving the nutritional value (Poutanen *et al*. 2019); and (4) organoleptic quality of the food (Lacroix *et al*., 2018, Sicard and Legras, 2011).

The common groups of microorganisms involved in food fermentations are bacteria, yeasts and moulds. The most important bacteria in the fermentation of foods are the Lactobacillaceae, which have the ability to produce lactic acid from carbohydrates. Other important bacteria are the acetic acid producing Acetobacter (mainly from fermentation of fruits and vegetables) and Bacillus (from fermentation of legumes) species. The beneficial yeasts in terms of desirable food fermentation are from the Saccharomyces family, especially S. cerevisiae. Fermentation of food grains is known to be an effective method of improving the starch and protein digestibility (Adebo *et al.,* 2022) and bioavailability of minerals (Chauhan *et al*., 2019). Fermentation also brings down the level of antinutrients like phytic acid and polyphenols (Sharma and Khetarpaul, 2016). Besides improving the digestibility, bioavailability of minerals and reducing the level of antinutrients, fermentation may also change the level of nutrients in the food grains. Indeed, during manufacture of these fermented cereal foods, nutrients including protein and minerals are lost from the grains thereby affecting nutritional quality adversely, as reported by Aminigo and Akingbala (2019).

Entrepreneurial education is therefore a course that is designed for students towards self-determination, self-employment and self-reliance in their field (Aminigo and Akingbala, 2019). It can be seen as training which includes a systematic and planned effort to develop knowledge and skills, attitudes, motivation and ability to develop business mind in trying to survive and contribute to national growth and development (Ayuba *et al*., 2016). The aim of entrepreneurial education is not to target high flying jobs, but to create the disposition that enable the individual to function well and be relevant to the economy of the nation, to live effectively, have high self-esteem, fight unemployment, poverty and thus become an employer of labour. For any society to be seen to developed, the educational system must aim at developing the cognitive, effective and psychomotor domains of her citizens through equipping individual with knowledge, attitude values and entrepreneurial skills, to develop the individual and the country at large (Olajide, 2019).

For Nigeria to take her place as a developed country strengthen her economy and reduce poverty, the urgent need for paradigm shift that entails training of students to become high skilled job creators, industrialist that can produced goods effectively need to be encouraged among Nigeria students especially Biology students (Olajide, 2019)**.** Biology is a subject that deals with the study of living organisms, including their structures, functioning, evolution, distribution and interrelationships (Sarojini, 2010). Biology occupies a unique position in the secondary school education curriculum because of its importance as science of life. Inclusion of entrepreneurial skills in biology will help shape Biology students career prospects such as medicine, pharmaceutical, neurosurgeon etc. In addition, the knowledge of Poultry in Biology helps in producing high quality entrepreneurial skills among Biology students. These advantages will enable students to acquire entrepreneurial skills that will help them to be self-employed.

microbial stability and safety and some can be stored even at ambient temperatures.

Maize is an excellent source of carbohydrate, but its protein quality is relatively poor because it is deficient in the essential amino acids lysine and tryptophan (Akinyemi *et al*., 2019). Maize is usually under cultivation as a mixed crop and thus only very small quantities are being produced for farmers' families. However, with the rapid expansion of livestock

industries in the country and the higher food demand by the ever – increasing population, the need to increase and improve on maize production is imperative. The higher demand for maize as food and industrial raw materials has placed high stress on supply of the commodity. The production of maize is basically done during rainy season, particularly in the Southern part of Nigeria. This result in land lying fallow, labour and time wasted in areas where rainfall is inadequate and unevenly distributed as we have in some part of the semi-arid areas. Irrigation practices are labour and capital intensive and require high technical know-how (skills) for their uses. Furthermore, many farmers in developing countries cannot afford to practice these various irrigation practices because of the cost of the equipment needed for their operations.

One of the problems cited as constraining the production of maize in Nigeria is stagnant production technology among Nigerian farming community, majority of who are small-scale producers. The reason for this could be attributed to resource productivity as studies have confirmed inefficiency in resource utilization in both food and cash crops in Nigeria. Furthermore, the extent to which inputs supply and productivity relates to a shortfall in food demand and supply in Nigeria is not clearly understood. At the same time, the impact of factors such as the policy environment, and the availability of markets for the disposal of farm outputs is not often considered despite the fact that such factors make farmers to work harder and thus, produce higher outputs (Olajide, 2019).

Currently maize cultivation in these countries is held back by a number of problems. One set of challenges relates to abiotic stresses. Most maize cultivation in the developing world is dependent on rainfall. This makes the crop particularly vulnerable to drought and heat. Current estimates suggest that 25% of maize production is threatened by frequent drought. It is widely accepted that these stresses will be become more acute as a result of climate change, resulting in a potential loss of up to 10% in maize production in Africa and Latin America by 2055. Other abiotic stresses include poor/degraded soil quality which is also seen as a significant contributing factor to poor yields. Maize cultivation is also affected by a range of biotic stresses including: Diseases such as downy mildew, rust, leaf blight, maize streak virus (MSV) and more recently, maize lethal necrosis (MLN) which has led to the total loss of maize crops in some parts of Nigeria. Insect pests such as the stem borer which can causes losses of 20-40%. Other stresses such as the parasitic Striga (witch) weed which has led to losses of 60-90% in some parts of Nigeria (Olajide, 2019). All these factors attracted the researcher to study the effect of fermentation on nutritional composition of corn seeds for inclusion into entrepreneurial biology in Mangu LGA of Plateau State.

The aim of the study was to determine the effects of fermentation on nutritional composition of corn varieties for inclusion into entrepreneurial biology in Mangu LGA of Plateau State.

MATERIALS AND METHODS

Study Area

The study area is Mangu town, headquarters of Mangu Local Government Area in Plateau State, Nigeria. Mangu has co-ordinates of9°31′00″N 9°06′00″E, and area of 1,653 km² and a population of 294,931 at the 2006 census (Alchetron (2026). The major ethnic group found in Mangu is the Mwaghavul People. They occupy the districts of, Panyam, Pushit, Kerang, Mangun, Kombun, Ampang West, and the Local government Headquarters (Mangu). Other ethnic groups include the Pyem (found in Gindiri), The Chakfem People (found in the southern hills of Jipal, and Chakfem) and the Kwanka or Kadung people inhabiting the northeastern in Kadunung. There are also some scattered Mupun settlements in Bwanzuhum Tilengten (Danazumi, 2014). Mangu Local government also host the Factory of Nigeria's first and most cherish bottled water; SWAN Spring Water, Located at the foot of the Kerang Volcanic Mountains. Mangu town is beehive of economic activities such as trading, concentration of auto mechanic workshops and farming.

In Mangu, the wet season is warm, muggy, and overcast and the dry season is hot and partly cloudy. Over the course of the year, the temperature typically varies from *55°F* to *91°F* and is rarely below *50°F* or above *96°F*. The vegetation type is largely of grasses, dotted with trees which in some places are single or in clusters. The vegetation along the rivers is generally richer because of the perpetual moisture that is associated with water courses. For this reason, the vegetation clusters along the rivers are conspicuous. The hills on the southern and western parts of Mangu Asali namely the Tullu wurang and Boras hills support a steady growth of trees especially on the Boras Hills which are put to economic use by the people as wood fuel and charcoal by blacksmiths.

Figure 1: Map of Mangu (Source: Google map retrieved January 25th, 2022)

Equipment: The Essential Equipment's used for the effect of fermentation on nutritional composition of corn varieties are analytical electronic balance, Soxhlet type extractor, UV- VIS spectrophotometer, Desiccators, Drying oven ventilated, Electrical heated vacuum oven, Incineration dish etc.

Reagents and Chemicals: The chemicals or reagents used for the effect of fermentation on nutritional composition of corn seeds are Hydrochloric acid, Sodium hydroxide, Potassium hydroxide, Chloroform, Methanol, Hydrogen sulphate, Sodium acetate, Acetone, Potassium sulphate, Copper sulphate, Phosphorus etc

Sample Collection and Processing

A Total of 1kg maize (Corn) varieties (white maize and pop-corn) were purchased in Mangu main market located in Mangu, Local Government Area of Plateau State. The maize (Corn) varieties (white maize and pop-corn) were purchased in Mangu main market located in Mangu, Local Government Area of Plateau State were gathered and sorted to remove the dead ones. The desired ones were cleansed thoroughly 2-3 times with running tap water, and finally with distilled water without squashing to remove debris and then dust particles. The maize (Corn) varieties were spread in a tray. The tray was now placed under direct sunlight away from animals and turned occasionally to ensure even drying. The maize (Corn) varieties were sun-dried for two days. They were then packed inside a container, labelled and stored in a separate tight container and taken to the Biochemistry Division of the National Veterinary Institute (NVRI), Vom, for fermentation procedures and the nutritional Analysis.

Administration Of Questionnaires

A total number of 100 well-structured questionnaires were carefully prepared and administered to study area respondents by the researcher. The questionnaires are all written in English Language. The questionnaires sought the respondents' information on the effects of fermentation on nutritional composition of corn varieties and also factors that improves the nutritional composition of corn varieties for inclusion into entrepreneurial biology in Mangu LGA of Plateau State.

Proximate analysis

The nutritional composition analyses (Moisture content, protein, Crude fibre (%), Lipids (%), Ash (%), NFE (%), Phosphorus (ppm) and Calcium (ppm) in the sample were determined using the method described by AOAC (2010). Crude fat was determined using the Soxlet system (Soxtecavante 2050), Crude protein and NFE were determine by Kjeldahl method using Kjeltec TM Model 2300 principle: The Soxlet equipment was used in the crude fat determination. Moisture content determination by the air oven drying method. Calcium, Phosphorus and the ash content were determined using different methods.

Statistical Analysis

Statistical analysis was carried out using one-way Analysis of Variance (ANOVA). Data were analysed using Graphpad Prism computer software. Data were expressed as the mean + standard error of mean and values at $P< 0.05$ were considered significant.

RESULTS

Table 1 below shows the Respondent's response on the effect of fermentation on nutritional composition of corn varieties. The total of 84% Respondents indicated that improve digestive health, boosting immune system, easier digestion of food, fermented foods may cause some initial side effects, such as gas and bloating and increased availability of beneficial nutrients are the effect of fermentation on nutritional composition of corn varieties while 13% of the respondents indicated No. Since F-value = 28.06, Fcrit(2,12)=3.89 at the $\alpha=0.05$ level, the result is statistically significant ($P<0.001$), indicating that the response distribution is not uniform across the categories.

Table 1: The Effect of Fermentation on Nutritional Composition of Corn Varieties

QUESTION ITEMS	Yes	No	No Opinion	Total
Improve digestive health	20(20%)	2(2%)	0(0%)	22(22%)
Boosts your immune system	12(12%)	4(4%)	2(2%)	18(18%)
Makes the food easier to digest	27(27%)	1(1%)	0(0%)	28(28%)
Fermented foods may cause some initial side effects, such as gas and bloating	15(15%)	5(5%)	1(1%)	21(21%)
Increased availability of beneficial nutrients	10(10%)	1(1%)	0(0%)	11(11%)
Total	**84(84%)**	**13(13%)**	**3(3%)**	**100(100%)**

(F-value = 28.06, Fcrit(2,12)=3.89 at $\alpha=0.05$ level, the result is statistically significant ($P<0.001$)

Table 2 below shows the factors that improve the nutritional composition of corn varieties. The total of 79% of the Respondents indicated that variety of corn, improve digestibility of starch, oil and protein, method of

processing/preparation of the corn, environmental condition of the corn of the corn and complementation with other foods

are the factors that improve the nutritional composition of corn varieties, 18% of the respondents indicated No and 3% of the

respondent indicated No. The result is statistically significant (P<0.001), confirming that the distribution of responses across the categories is not uniform and shows a strong bias toward the "Yes" response.

Table 2. The Factors that Improve the Nutritional Composition of Corn Varieties

QUESTION ITEMS	YES	NO	NO OPINION	Total
The variety of corn	19(19%)	3(3%)	0(0%)	22(22%)
Improve digestibility of starch, oil and protein of the corn	14(14%)	6(6%)	2(2%)	22(22%)
Method of processing/preparation of the corn	25(25%)	0(0%)	1(1%)	26(26%)
Environmental condition of the corn	13(13%)	6(6%)	0(0%)	19(19%)
Complementation with other foods	8(8%)	3(3%)	0(0%)	11(11%)
Total	**79(79%)**	**18(18%)**	**3(3%)**	**100(100%)**

(F-value = 20.39, Fcrit (2,12) =3.89 at the α=0.05 level, the result is statistically significant P<0.001).

Table 3 and figure 2 below shows the statistical proximate nutritional analysis of white corn and pop-corn varieties respectively. The result clearly indicated that the moisture content of white corn (11.11±0.51) is higher than that of pop-corn (6.48±0. 03), The crude protein content of pop-corn (7.47±0. 02) is higher than that of the white corn (6.79±0. 01). White corn has higher index dietary fiber with a value of 23.79±0. 02, more than the pop-corn (22.58±0. 07). White corn has a higher value of Lipids (9.51±0.05), Ash (4.94±0.05), more Lipids value (4.35±0.15), and Ash (4.58±0.01) value of pop-corn. White corn has a higher NFE content with a value of 62.74±0.01 compared to that of pop-corn (61.55±0. 01). White corn calcium content value is 1.98±0.02, which is higher than that of pop-corn (1.34±0.01). White corn possesses higher Phosphorus content with a value of 0.23±0.01 compared to that of Pop-corn (0.14±0.00).

Table 3. Result of Statistical analysis (ANOVA) of the Proximate Composition of White corn and Pop-corn

Parameters	White corn	Pop-corn	p-value	LOS
Moisture (%)	11.11±0. 51	6.48±0. 03	0.012	*
Crude protein (%)	6.79±0. 01	7.47±0. 02	<0. 0001	*
Crude fibre (%)	23.79±0. 02	22.58±0. 07	0. 003	*
Lipids (%)	9.51±0. 05	4.35±0.15	0. 001	*
Ash (%)	4.94±0.05	4.58±0.01	0.018	*
NFE (%)	62.74±0.01	61.55±0. 01	<0.0001	*
Calcium (ppm)	1.98±0.02	1.34±0.01	0.001	*
Phosphorus (ppm)	0. 23±0.01	0. .14±0. 00	0.003	*

Note: Values are expressed as mean ± SEM; NS= Not significant, LOS= Level of Significance, * = significant at P<0.05

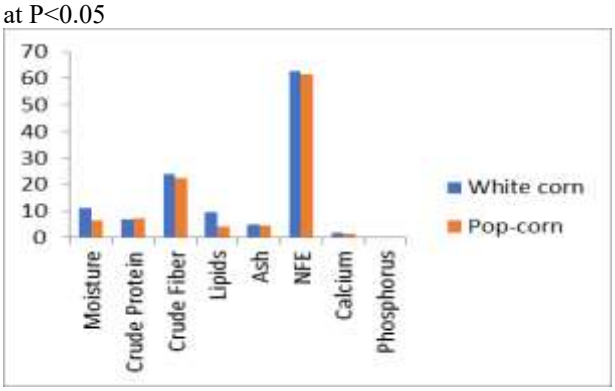

Figure 2: Chart showing result of Statistical analysis (ANOVA) of the Proximate Composition of White corn and Pop-corn

DISCUSSION

Maize in Sub-Saharan Africa: Importance and Production Constraints (Niyomugabo, 2025; Badu-Apraku and Fakorede, 2017). Maize and other cereal grains constitute important sources of carbohydrates, proteins, vitamin B, and minerals. Maize is source of fat, vitamin A and vitamin E. 100 g of maize meal have provided 50% or more of the average adult daily requirement of linolenic acid and 20% of vitamin E (Melini *et al.,* 2019). The importance of cereal grains to the nutrition of millions of people around the world is widely recognized. This study was carried out to determine the effects of fermentation on nutritional composition of corn varieties for inclusion into entrepreneurial biology in Mangu LGA of Plateau State.

Analyses of the Respondent's response on the effect of fermentation on nutritional composition of corn varieties shows that the total of 84% respondents indicated that improve digestive health, boosting immune system, easier digestion of food, fermented foods may cause some initial side effects, such as gas and bloating and increased availability of beneficial nutrients are the effect of fermentation on nutritional composition of corn varieties while 13% of the respondents indicated "No". Hence, the result is statistically significant (P<0.001), indicating that the response distribution

is not uniform across the categories. This result is in agreement Adejumo *et al.,* (2016) and Osinubi *et al.,* 2020 who reported that improve digestive health, boosting immune system, easier digestion of food, fermented foods may cause some initial side effects, such as gas and bloating and increased availability of beneficial nutrients are the effect of fermentation on nutritional composition of corn varieties. This indicated that fermented foods are very good for the body system and to maintain healthy living (Osinubi *et al.,* 2020).

Analyses of the Respondent's response on factors that improves the nutritional compositions of corn varieties shows that the total of 79% Respondents indicated that variety of corn, improve digestibility of starch, oil and protein, method of processing/preparation of the corn, environmental condition of the corn of the corn and complementation with other foods are the factors that improve the nutritional composition of corn varieties. 18% of the respondents indicated No while 3% of the respondent had "No", hence the result is statistically significant at P<0.00, confirming that the distribution of responses across the categories is not uniform and shows a strong bias toward the "Yes" response. This result is in agreement Ayuba *et al*., 2016 who reported that variety of corn, improve digestibility of starch, oil and protein, method of processing/preparation of the corn, environmental condition of the corn of the corn and complementation with other foods are the factors that improve the nutritional composition of corn varieties.

The proximate nutritional analysis of White corn and the Pop-corn clearly indicated that there is a statistically significant difference (P<0.05). White corn has a higher moisture content (11.11±0.51) than pop-corn (6.48±0. 03). This finding collaborates with the work of Akonbi, *et al,* (2018) who also recorded high moisture content in spring season. It is also in accordance with Ayuba *et al*., (2016) who noted that weather conditions, harvesting time, environmental factors such as temperature, oxygen, water activity and pH could lead to the increased in the moisture content. The decreased in moisture content of the pop-corn signifies more and longer storability because the lower the moisture contents of a sample, the more its storability. The crude protein content of pop-corn (7.47±0. 02) is higher than that of the white corn (6.79±0. 01). This indicated that pop-corn have more protein than white corn. This is in agreement with the research done by (Osinubi *et al.,* 2020) who recorded (7.45) crude protein values for Pop-corn. Ibok (2018) indicating that pop-corn may be another cheap source of protein for the marginal resource communities of Nigeria especially in Pankshin, Plateau State. Diet is nutritionally satisfactory, if it contains high caloric value and a sufficient amount of protein (Ibok, 2018). Any foods that provide about 12% of their calorific value from protein are considered good source of protein (Adejumo *et al.,* 2016; Osinubi *et al.,* 2020). White corn has a higher index dietary fiber with a value of 23.79±0. 02, compared to white bread (22.58±0. 07). This makes the Pop-corn a more favourable carbohydrates since high fibre content of foods help in digestion and prevention of colon cancer (Ibok *et al*., 2018). Non-starchy carbohydrates are the richest sources of dietary fibre. High crude fiber content showed low digestibility compared to other cell contents. Therefore, white corn could be recommended as crude fibre source in the diet as a result of their relative high crude fibre content.

White corn has higher value of Lipids (9.51±0.05) compared to Pop-corn (4.35±0.15). These high values in white corn were due to good production ingredients and the production environment (Ayuba *et al*., 2016). Dietary fats function in the increase of palatability of food by absorbing and retaining flavors. A diet providing 1 - 2% of its caloric energy as fat is said to be sufficient to human beings, as excess fat consumption yields to certain cardiovascular disorders such as atherosclerosis, cancer and aging (Ibok 2018). White corn also has a higher value of Ash (4.94±0.05) compared to pop-corn (4.58±0.01). The proportion of ash content is a reflection of the mineral contents preserved in the food materials. The result could suggest a high deposit of mineral elements in the White corn than the white bread. Nitrogen free extract (NFE) was not affected by seasonal variations as the white corn possess higher NFE content with a value of 62.74±0.01 compared to pop-corn (61.55±0. 01). High level of starch in maize is good for animals because it is easily digestible and provides energy readily. The amount of starch increased with maturity of plants under low moisture and high temperature.

The calcium (ppm) content of white corn (1.98±0.02) is higher than that of pop-corn (1.34±0.01). Calcium generally helps in maintenance of acid-base balance, response of nerves to physiological stimulation and blood clotting. This indicates that calcium in the White corn plays a good role in the maintaining of acid alkaline balance in the body. White corn possess higher Phosphorus (ppm) content (0.23±0.01) compared to the pop-corn (0.14±0.00). Phosphorus is considered to be essential in human nutrition. This phosphorus is vital for the overall mental physical well-being and are important constituent of bones, teeth, tissues, muscles, blood and nerve cells. The high phosphorus content in the White corn could indicates that phosphorus is needed for bone growth, kidney function and cell growth of the body. This present study agrees with the work of Ayuba *et al.,* (2016) who carry out the macronutrient composition and glycemic index of varied prepared meals of Irish potatoes and discovered that spring Season maize was found to have high nutrients.

CONCLUSION

Based on the findings, the study concludes that white corn is more nutritious than the pop-corn. This indicate that white corn has more nutritious carbohydrate that provide sufficient amount of nutrients and energy needed for normal body growth, function, maintenance and reproduction. Result of the analyses of Respondent's response on the effect of fermentation on nutritional composition of corn varieties shows a statistically significant difference (P<0.001). There is a statistically significant difference on the Respondent's response on the factors that improves the nutritional

composition of corn varieties in the study area (P<0.001). Proximate nutritional analysis of white corn and pop-corn varieties respectively and showed a statistically significant difference (P<0.001)). The moisture content of white corn (11.11±0.51) is higher than that of pop-corn (6.48±0. 03), The crude protein content of pop-corn (7.47±0. 02) is higher than that of the white corn (6.79±0. 01). White corn has higher index dietary fiber with a value of 23.79±0. 02, more than the pop-corn (22.58±0. 07). White corn has a higher value of Lipids (9.51±0.05), Ash (4.94±0.05), more Lipids value (4.35±0.15), and Ash (4.58±0.01) value of pop-corn. White corn has a higher NFE content with a value of 62.74±0.01 compared to that of pop-corn (61.55±0. 01). White corn calcium content value is 1.98±0.02, which is higher than that of pop-corn (1.34±0.01). White corn possesses higher Phosphorus content with a value of 0.23±0.01 compared to that of Pop-corn (0.14±0.00).

The study recommends that available resources and financial support should be provided by the government to farmers for the production of white corn. Also, government and other non-governmental agencies (NGOs) should create more public awareness on the nutritional value of white corn via symposiums, social media, seminars etc. The researcher also recommends that people should always eat white corn as it was found to be better and more nutritious in providing essentials nutrients and energy needed for normal body growth, function, maintenance and reproduction.

CONFLICT OF INTEREST

The authors have all declared no conflict of interest.

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