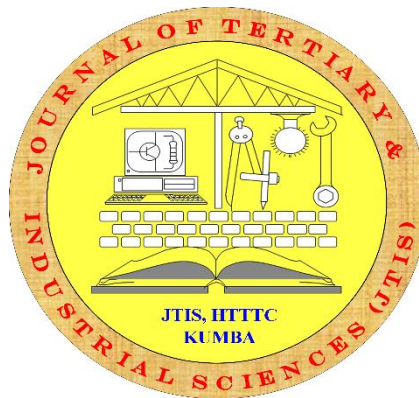


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P.O Box: 249 Buea Road, Kumba

Tel: (+237) 33354691 – Fax: (+237) 33354692

Email: editorinchief@httckumba.com

Website: <http://www.httckumba.com>

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FORMULATION AND SENSORY EVALUATION OF COOKIES ENRICHED WITH TIGER NUTS

By

MOFORMI CARINE BILE, EBONG FIDELIS SAMEH¹

Abstract

This study is titled the formulation and Sensory Evaluation of Cookies Enriched with Tiger nuts (*Cyperus esculentus*). The main objective of the study was to produce cookies enriched with tiger nuts flour, and one of the specific objectives was evaluating the organoleptic properties and overall acceptability of cookies enriched with tiger nuts. To achieve this study, partial substitute of wheat flour was added to tiger nuts flour in the production of cookies. Fresh tiger nuts were sorted, washed, dried at 105°C for 30 minutes, cooled, milled and sieved to obtain tiger nuts flour. Four cookies' samples were produced labelled A to D. Sample A was made of 100% wheat flour, sample B was made of 50% wheat flour and 50% tiger nuts flour, sample C was made of 80% wheat flour and 20% tiger nuts flour and sample D was made of 100% tiger nuts flour. The sample technique used was the random sampling. Sensory evaluation was carried out to assess the organoleptic properties of these cookies samples and also to determine the consumer general acceptability. The sensory evaluation showed that the cookies varied in taste, texture, flavour and appearance. The addition of tiger nuts flour produced cookies with good taste, texture, flavour and appearance. The results showed that all cookie samples were generally accepted but the least preferred was sample D which was produced completely with tiger nuts flour. Sample C was accepted by almost all the panellists giving it 90%, followed by sample A with 80%, sample B with 50% and the last sample D with 25%. The research indicates that enriched cookies could be produced from wheat flour blended with tiger nuts flour and up to 20% level of tiger nuts flour addition is recommended based on the sensory evaluation results.

Keywords: Cookies, wheat, tiger nuts, general acceptability, enriched.

1. Introduction

Cookies are one of the foremost prevalent bakery products made from cereal that are consumed by nearly all individuals in the world. They are snacks produce from dough that is changed into an interesting product by baking (Ndife et al., 2017). Cookies are made with wheat flour, sugar, milk, fat, flavouring agents and other raising agents (Oladoye et al., 2018). Cookies are ready-to eat, convenient and cheap nourishment item, containing digestive and dietary filaments which are crucial to the body

¹ Department SEFM Higher Technical Teachers' Training College (HTTTC), Kumba, University of Buea, P.O. Box 63, Buea, South West Region, Cameroon

(Gustafson, 2019) cookies are wealthy source of fat and carbohydrate, subsequently are vitality giving food and they are moreover a great source of protein and minerals (Ndife et al., 2017). Over the years, there has been an increasing demand for cookie-like products. Consumer's demand has expanded for the quality food products with taste, safety, convenience and nutrition (Jyotsna et al., 2017). Wheat flour is a staple ingredient in the production of cookies due to its protein and gluten content, which is not found in other grain flour. Wheat flour is gotten from the grinding of wheat and it is utilized in the preparation of pastries, batters and dough. Some essential amino acids such as lysine, tryptophan and threonine are missing in wheat flour (Ishiwu, 2019). Thus, the Moo nutritional value of cookies is of extraordinary concern as cookies are the most consumed snacks by school children who need more protein per unit body weight than adults. Wheat is primarily utilized as the grain of choice for production of this nibble product, however, due to climatic conditions; it is not grown in tropical regions of Cameroon. As demand increases, there is a propensity for wheat flour prices to increase, as well as an increase in the cost of importing it into the country (Barbiker, 2017) this high cost is due to the fact that population growth has increased. Therefore, the search for lesser known and under-utilized crops, many of which are potentially valuable as human and animal food has been intensified to maintain a balance between population growth and agricultural productivity, particularly in the tropical and subtropical areas of the world.

The worsening food crisis and the consequent widespread prevalence of malnutrition in developing and underdeveloped countries have resulted in high mortality and morbidity rates, especially among infants and children in low-income groups. Recently tiger has been seen as an excellent crop that can be blend with other crops to produce nutritive food product.

Tiger nut (*Cyperus esculentus*) is underutilized crop, which has high dietary fibre content and it is very effective in the treatment and prevention of many diseases including colon cancer, coronary heart diseases, obesity, diabetics and gastro intestinal disorders (Schroeder, 2018). Tiger nut flour has been demonstrated to be a rich source of quality oil and contains moderate amount of protein, carbohydrate, sugars, phosphorus and potassium (Oladele et al., 2017). It is also an excellent source of some useful minerals such as iron and calcium which are essential for body growth and development (Prakash et al., 2019). It is often eaten raw, baked as a vegetable, roasted or dried and ground into flour. The grind flour is mixed with sorghum to make porridge, ice-cream, sherbet or milky drink (Mahmoud et al., 2017). Therefore, a blend of wheat and tiger flour in the production of cookies will go a long way to solve the issue of wheat deficiency and also reduce the use of sugar, milk and fat in the production of cookies since tiger nut is rich in milk, fat and sugar.

This study will help us to understand and better appreciate the use of tiger nuts to enrich cookies. It is hoped to be of importance to bakeries as it will help in the possibility of using tiger nuts in enriching cookies. This will improve the nutrient content of these cookies and reduce the import of wheat flour. The consumption of

cookies with more nutrients will improve the consumer's health leading to a healthier population. Since wheat is poor in nutrients, the consumption of cookies enriched with tiger nuts will help make up for nutrients that are absent. This study also is of great significance to the food processing industry, to researchers and the society at large in the following ways:

Provide solution to the problem of protein, energy, malnutrition in Cameroon and Africa in general

Provide a documented protocol for the production of cookies made with a blend of wheat and tiger nut.

Provide a wide opportunity for entrepreneurship in the area of baked products.

Provide new opportunities for utilizing tiger nuts.

To other researcher, this study will add to already existing studies related to this topic. This will eventually lead to an increase in the body of knowledge in the field of study. More so, the appraisals and criticism that will result from this study will act as a stepping stone for other studies to be conducted by other researchers.

1.2 Tiger nuts Origin and Geographical Distribution

Tiger nut is one of the wild edible plants that could be used to improve human nutrition. It contributes significantly towards improving the economy and cultural life of people residing in rural communities in Sub-Saharan Africa (Bamishaiye et al., 2017). The origin of tiger nut can be traced to ancient Egypt (Ahmed et al., 2018). The discovery of dry tiger nut tubers inside tombs in Egypt which dates back to 6,000 years ago is strong evidence to support the claim that the cultivation of tiger nut started in Egypt. Back then in Egypt, tiger nut tubers were roasted and used as sweet meat (FAO 2018). Tiger nut is well distributed in Chile, Brazil and USA. It naturally grows in Cameroon, Ghana, Nigeria and Sierra Leone. Cultivation of tiger nut takes place in other West African countries such as Cameroon, Senegal, Guinea and Cote d'Ivoire. In Nigeria, tiger nut is grown mainly in the northern region and the tuber is available in the market all year round (Bamishaiye et al., 2017). Tiger nut can also grow in the middle belt of Cameroon. It grows luxuriantly in wet marshes and areas close to streams (Bamishaiye et al., 2017).

Tiger nut is a perennial monocotyledon plant which has a tough erect fibrous root. The slender rhizomes of tiger nut form weak runners above the ground level which develop small-sized tubers at the tip of the stem. Tiger nut tubers can reach about six inches depth into the soil. The size of the tubers can be compared with that of peanut. The central erect stem of tiger nut is usually covered by sheath of leaves (Bamishaiye et al., 2017). The botanical name of tiger nut is *Cyperus esculentus* L. It has other names depending on the tribe or region where tiger nut tuber is cultivated and utilized. The genus name *Cyperus* is derived from an ancient Greek name *Cyperus* whereas the specie name *esculentus* originate from a Latin word which means edible (Ayeh-Kumi et al., 2014). Tiger nut is also called 'Zulu nut', 'Yellow nut sedge',

'Chufa', 'Flat sedge', 'Edible rush nut', 'Water grass', 'Almond', 'Northern nut grass' and 'Nut grass'. The Hausas call tiger nut tubers 'Aya (FAO, 1988). A widely acceptable name given to tiger nut tubers in Cameroon is 'Hausa cola' which literally describes a nut that is largely cultivated and marketed by the Hausas that dominate Northern Cameroon. Tiger nut is a member of the family Cyperaceae. So far, approximately 4,000 species of tiger nut plant have been identified. In some countries, tiger nut is regarded as a wild plant commonly used as animal feed (FAO 1988). *Cyperus esculentus* is very popular because the tubers are directly consumed in its raw form. Tiger nut tubers have a slightly sweet and nutty flavour. The texture and flavour of tiger nut tuber is comparable with coconut. Fresh, semi-dried or dried tiger nut tuber is usually consumed as a snack because of its nutty flavour. Many people who eat tiger nut tubers are not well informed about the variety of products that could be derived from the tubers and their benefits.

There are three varieties of tiger nut tubers easily identified based on the colour of the tubers. They are: the yellow, brown and black variety. Only two of the varieties - yellow and brown are commonly seen in most local markets in Cameroon, Nigeria and Ghana. The yellow variety is further grouped into two - the large yellow variety and the small yellow variety (Bamishaiye et al., 2017). The botanical name *Cyperus esculentus* is commonly used in most literature. For the purpose of this work, the yellow variety was used.



Figure 1: Big size yellow variety tiger nut tubers. Source: Nwaoguikpe, 2010

Table 1: Proximate composition (%) of wet and dried tiger nut tubers (*Cyperus esculentus*) varieties

| Composition | Wet C. esculentus (L) | Dried C. esculentus(L) | Wet C. esculentus(S) | Dried C. esculentus(S) |
|---------------|-----------------------|------------------------|----------------------|------------------------|
| Ash | 1.80±0.01 | 2.68±0.20 | 1.75±0.10 | 1.79±0.0 |
| Moisture | 42.80±0.20 | 32.16±0.20 | 24.22±0.1 | 9.7±0.1 |
| Crude fibre | 18.0±0.1 | 21.36±0.0 | 15.27±0.10 | 15.60±0.0 |
| Crude lipid | 14.10±0.0 | 19.67±0.1 | 11.50±0.0 | 27.54±0.0 |
| Crude protein | 4.82±0.1 | 7.94±0.1 | 3.65±0.20 | 3.94±0.1 |
| Carbohydrate | 18.44±0.2 | 16.19±0.2 | 16.39±0.1 | 15.60±0.0 |
| Energy (KJ) | 213.90 | 317.61 | 183.50 | 326.02 |

L represents 'large sized tiger nut tubers'; S represents 'small sized tiger nut tubers'

Source: Nwaoguikpe, 2010

Table 2: Mineral composition (mg/100 g) of fresh and dried tiger nut (*Cyperus esculentus*)

| Mineral | Fresh <i>Cyperus esculentus</i> | Dried <i>Cyperus esculentus</i> |
|---------|---------------------------------|---------------------------------|
| Fe | 41.75±1.104 | 158.49±0.124 |
| Zn | 34.77±0.0877 | 22.763±0.727 |
| Cu | 41.05±0.112 | 52.35±0.112 |
| Pb | 0.36±0.0895 | 2.05±0.112 |

Source: Chukwu et al., 2016

Table 3: Proximate composition (%) of yellow, brown and black varieties of *Cyperus esculentus*

| Composition | C. esculentus (Yellow variety) |
|---------------|--------------------------------|
| Ash | 3.97 |
| Moisture | 3.50 |
| Crude fibre | 6.26 |
| Crude lipid | 32.13 |
| Crude protein | 7.15 |
| Carbohydrate | 46.99 |
| Energy (KJ) | 1343 |

Source: Nwaoguikpe, 2010

1.2.1 Tiger nuts Flour

Tiger nuts flour is a dry and fine powdery material obtained after grinding and sieving dried tiger nut tubers. It has useful application in food formulations (Adejovitan, 2009). A blend of tiger nuts flour in different proportions with other types of flour for

the development of different products had been carried out by many researchers. Since tiger nuts flour does not contain gluten, it is ideal for people who restrain themselves from diets that contain gluten because of health challenges linked to gluten. On the other hand, the flour obtained from the yellow variety tiger nuts tubers contain higher carbohydrate, crude fibre, calcium, sodium and copper than the flour obtained from the brown variety tiger nuts tubers (Oladele, 2009). Fermentation of tiger nuts tubers before the dried tuber is ground into flour improves the nutritional content of tiger nuts flour (Adejovitan, 2009). The result presented in Table 4 shows the mineral content and proximate composition of tiger nuts flour obtained separately from yellow and brown tiger nuts varieties.

Table 4: Mineral content and proximate composition of flour obtained from two varieties of tiger nuts tubers

| Mineral element/constituent | Yellow tiger nuts flour |
|------------------------------------|--------------------------------|
| Calcium (mg/100 g) | 155 |
| Sodium (mg/100 g) | 245 |
| Potassium (mg/100 g) | 216 |
| Magnesium (mg/100 g) | 51.2 |
| Manganese (mg/100 g) | 33.2 |
| Phosphorus (mg/100 g) | 121 |
| Iron (mg/100 g) | 0.65 |
| Zinc (mg/100 g) | 0.01 |
| Copper (mg/100 g) | 0.02 |
| Moisture (%) | 3.5 |
| Fat (%) | 32.13 |
| Protein (%) | 7.15 |
| Ash (%) | 3.97 |
| Carbohydrate (%) | 46.99 |
| Crude fibre (%) | 6.26 |
| Energy scale (KJ) | 1343.00 |

Source: Oladele, 2009

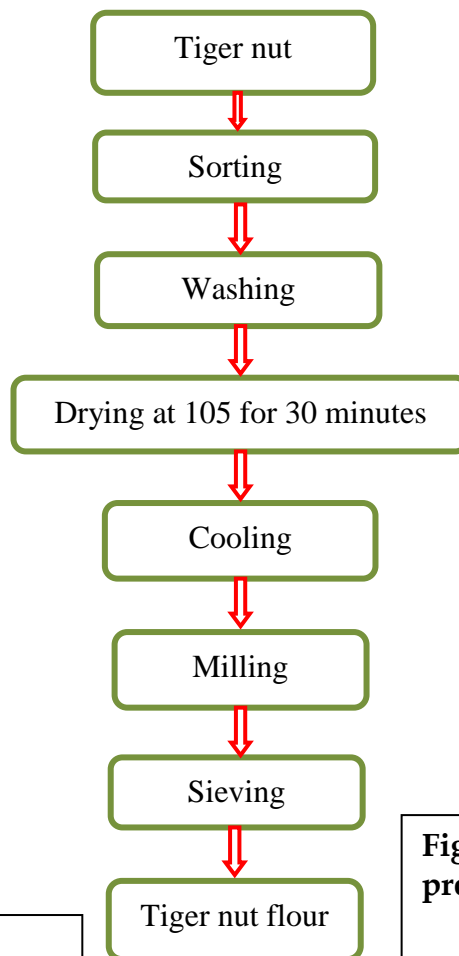
1.2.2 Cookies

With global travel becoming widespread at that time, cookies made a natural travel companion, a modernized equivalent of the travel cakes used throughout history. One of the most popular early cookies, which travelled especially well and became known on every continent by similar names, was the jumble, a relatively hard cookie made largely from nuts, sweetener, and water. Cookie is a baked or cooked snack or dessert that is typically small, flat and sweet. It usually contains flour, sugar, egg, and some type of oil, fat, or butter. It may include other ingredients such as raisins, oats, chocolate chips, and nuts. Cookie-like hard wafers have existed for as long as baking is documented, in part because they survive travel very well, but they were usually not sweet enough to be considered cookies by modern standards.

2. Materials and Method

The production of the tiger nut flour, production of enriched cookies made from tiger nut flour, wheat and other ingredients and the sensory evaluation are based on the methods described in Akajiaku et al. (2018). Wheat flour (Golden Penny), sugar, fat, milk, salt, baking powder and fresh tiger nuts (yellow variety) were purchased from Kumba main market. Equipment/materials such as blender, mixer, kneader, spoons, knife bowl digital weighing scale, measuring cylinder, baking pans, oven, stirrer, 0.45mm mesh-size sieve, spatula portable water were obtained from the home economics laboratory of government Technical High School Kumba.

Dry tiger nuts (yellow variety) tubers were sorted to remove unwanted materials like stones, pebbles and other foreign seeds, before washing with portable water dried in an oven at 105°C for 30 minutes. The dried nuts were milled and sieved through 0.45 mm aperture size. The resultant flour was packed in polyethylene bag and stored in a container with air-tight lid at room temperature and retain in the laboratory for the production of the cookies. The flow chart for the production of tiger nut flour is shown on the figure below.



Source: researcher, 2023

Figure 2: Flow diagram for the production of tiger nut flour

2.1 Production of Enriched Cookies using Tiger nut Flour and Wheat Flour at different mixed proportions.

The production of the cookies was based on the slightly modified method of Akajiaku et al. (2018). As shown in the tables below two samples of cookies will be produced with a blend of wheat and tiger nuts at 50% and 50% respectively (sample B) and 80% and 20% (sample C) and also two other sample shall be made with 100% tiger nut flour (sample D) and 100% wheat flour (sample A). As also listed in tables below, all ingredients will be weighed. The dry ingredients will be mix together before adding the wet ingredients to form a dough consistency required for cookies. The dough will be kneaded and flatten before cutting in to different desired shapes. The oven will be pre-heated and baking will be done at 200°C 1hour for each sample. The cookies will be allowed to cool, and package and kept for sensory evaluation. The table below presents the recipe for the production of cookies.

Table 5: recipe for the production of cookies

| | Ingredient | Samples | | | |
|----|-----------------|---------|---------|---------|---------|
| | | A | B | C | D |
| 1 | Wheat flour | 100 % | 50 % | 80 % | 0% |
| 2 | Tiger nut flour | 0 % | 50 % | 20 % | 100% |
| 3 | Baking fat | 350 g | 350 g | 350 g | 350g |
| 4 | Sugar | 450 g | 250 g | 350 g | 200g |
| 5 | Baking powder | 5 tsp | 5 tsp | 5 tsp | 5tsp |
| 6 | Salt | 3/5 tsp | 3/5 tsp | 3/5 tsp | 3/5 tsp |
| 7 | Water | 50 ml | 50 ml | 50 ml | 50 ml |
| 8 | Milk | 420 ml | 250 ml | 350 ml | 200 ml |
| 9 | Raisins | 500 g | 500 g | 500 g | 500 g |
| 10 | Egg | 4 | 4 | 4 | 4 |
| 11 | Flavour | 5 tsp | / | / | / |

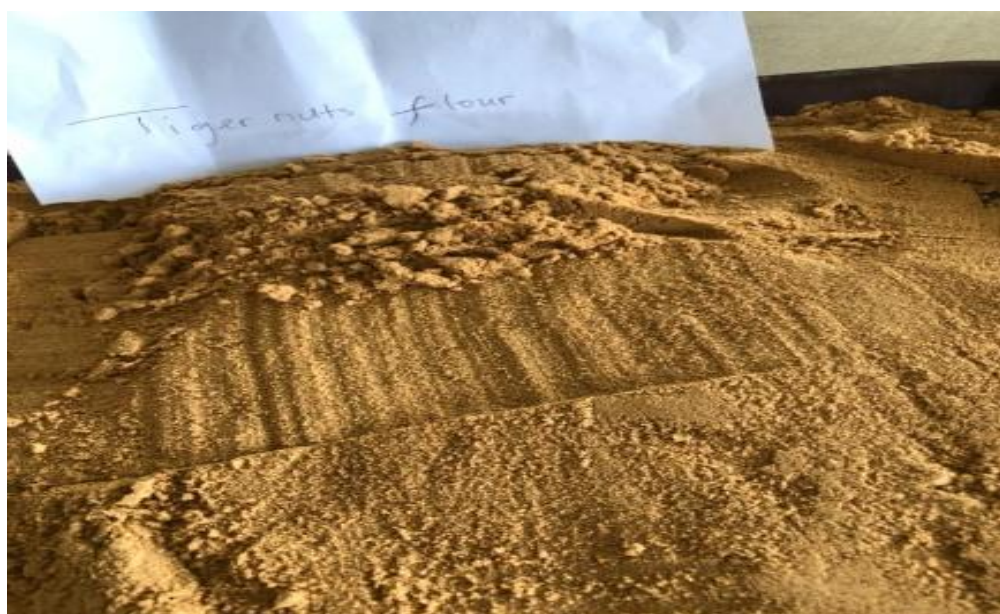
2.2 Sensory Evaluation

Thirty semi trained panellists were randomly selected from the department of Social Economy and Family Management, Higher Technical Teachers' Training College Kumba for the sensory evaluation on the cookie samples. These samples were evaluated for appearance, texture, flavour, taste, and overall acceptability. Panellists were provided with water to rinse their mouth between each sample evaluation. The cookies samples were analysed using a 9-point hedonic scale and colleagues will be used for rating, where 9 = liked extremely, 8 = liked very much, 7 = liked moderately, 6 = like much, 5 = neither like nor dislike, 4 = dislike, 3 = dislike moderately, 2 = dislike very much and 1 = dislike extremely.

3. Results and discussions

3.1 Tiger Nut Flour

There is a lot of work done on tiger nuts in open literature, some of this work has focused on the production of tiger nut cockles from 100 percent tiger nut flour such as work done by Akajiaku et al 2018. This work focused on the effects of varying amount of tiger nuts and wheat flour to study the effects on sensory characteristics. After carrying out the procedure as described in the method, it was possible to obtain 100 % tiger nut flour as shown on Figure 3 below. The picture below depicts tiger nut flour produced for this study. The flour was produced with the use of the yellow variety of tiger nut as mentioned earlier.



Source: researcher, 2023

Figure 3: Tiger nuts flour

3.2 Cookies Produced at Different Combinations of Wheat Flour and Tiger nut Flour.

Cookies were baked as described in the method in different combinations of tiger nuts and wheat flour as shown by A, B, C and D respectively as shown on Figure 4. As shown on the figure there is clear evidence on the physical appearance of the cookies with 100 percent wheat flour as compared to those with tiger nuts or 100 percent tiger nuts. However, using sensory analysis it will be possible if the physical appearance had an effect on the general acceptability of the end product. T. Figure 4 below shows how the control sample for this study, produced with 100% wheat has effect on the appearance.



Source: Field research work, 2022

Figure 4: Cookies produce with wheat flour (100%)-A, Cookies produce with a blend of tiger nut flour (50%) and wheat flour (50%)-B, Cookies produce with tiger nut flour (20%) and wheat flour (80%)-C Cookies produce with tiger nut flour only (100%)-D tiger nuts.

3.3 Sensory Evaluation

The sensory evaluation of this study was based on the taste, texture flavour, appearance, and overall acceptability of the sample using a 30 semi trained panellists on 9-point hedonic scale with 9 = extremely like and 1= extremely dislike. The samples were presented to the panellists on a tray whereby they were to wash their hands and dry them with a hand napkin and pick each of the sample test and evaluate. The data collected were treated and edited to ensure consistency and processed using the statistical package for social sciences (SPSS). The percentages presented in the table below were calculated from

$$\text{Percentages} = \frac{f}{N} \times 100$$

Where:

f: frequency

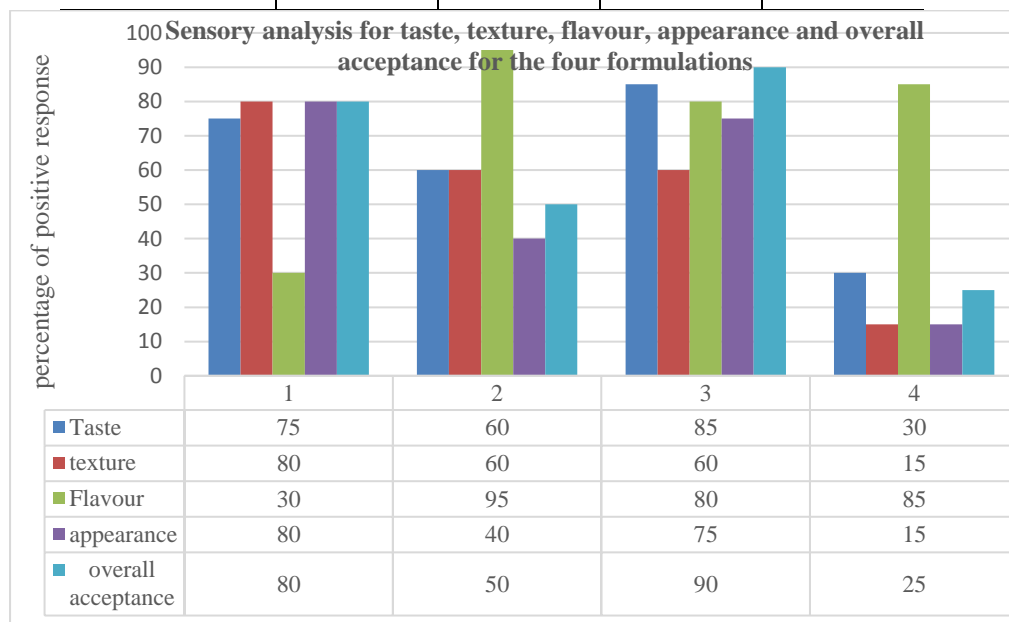
N: Total count (total frequency)

The results are presented in the overall percentage of like for the sensory quality for each sample.

3.4 Discussions

Table 6: Response on sensory evaluation of 30 trained participants for samples A, B C and D

| Parameter | A (%) | B (%) | C (%) | D (%) |
|--------------------|-------|-------|-------|-------|
| Taste | 75 | 60 | 85 | 30 |
| Texture | 80 | 60 | 60 | 15 |
| Flavour | 30 | 95 | 80 | 85 |
| Appearance | 80 | 40 | 75 | 15 |
| Overall acceptance | 80 | 50 | 90 | 25 |



Source: Field research work, 2022

Figure 5: Result for sensory evaluation, as produced by the trained participants. Results are for sample A, B, C, and D represented by 1, 2, 3 and 4 respectively.

The table 6 above is the percentages score on the sensory evaluation of the sample used for this study. The taste of the samples is an important factor to consumers so it was evaluated and of the 30 panellist who participated in the sensory evaluation 75% liked the taste of the cookies produce with wheat flour. 60% of the participants liked the taste of cookies produce with tiger nuts flour proportioned at 50% of the total weight of the flour used and wheat flour also proportioned at 50% of the total weight flour and 85% of the panellist liked the taste of the sample made with tiger nut flour proportioned at 20% and wheat flour proportioned at 80% While 30% of the panellist

liked the sample made with tiger nut proportioned at 100% (that is only tiger nut flour). Figure 5 presents the graphical representation of the result.

3.5 Discussions

The aim of this study was to produce cookies enriched with tiger nuts flour. After producing four samples' cookies, sensory evaluation was carried out on the organoleptic characteristics of the samples to evaluate the appreciation of the baked cookies. After data were collected and analysed, it was realised that flour can be produced with tiger nuts and cookies can be enriched with tiger nut flour. This study revealed that sample C (cookies produce at 80% wheat flour and 20% tiger nut flour) had the best taste and the control sample had the best texture. This was because the proportion of tiger not flour added to the wheat actually satisfied the qualities of cookies that is desired by the panellists. This implies that cookies enrich at 20% tiger nut flour will go a long way to satisfy the nutritive demands for cookies consumers.

This study showed that sample B (cookies produce with 50% wheat flour and 50% tiger nut four) has the best flavour. This is as result to the fact that when tiger nut flour is used for baking it produces delicious flavour. So therefore, a blend of tiger nut flour and wheat flour at 50% each in the production of cookies leads to amazing flavoured cookies but the realized seems to be over enriched. Also, the study revealed that the control sample (cookies produce with 100% wheat flour) had the best appearance, this due to the fact that the gluten present in the wheat flour was also at 100% the weight of the flour used, thus, the end product is having the desired stable appearance. Looking at figure 5, it can be seen that sample D has the least overall approval. It is thus recommended to add wheat flour in the formulation of the product. Also sample D (cookies produce with 100% tiger nut flour) was the least preferred because it was extremely enriched and the appearance is relatively unpleasant.

4. Conclusion

Based on the result gotten from this study we conclude that the result of this study has shown tiger nut flour can be produced locally and can be used to enrich cookies. The production of cookies using tiger nut is a means to increase the nutritive value of cookies due to the too much nutritional content present in tiger nuts. The use of tiger nut in the production of cookies has many important implication and usefulness to the entire society. According to the samples analyse above, the researchers are adopting that the production of cookies using tiger nut flour should be proportioned at 80% wheat flour and 20% tiger nut flour. It is worth noting that, the application of tiger nut flour in bakery and pastry product should be given it desired interest in the domain of food processing.

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