SENSORY EVALUATION AND PROXIMATE COMPOSITION OF WEANING FOOD FROM MAIZE, SOYBEAN AND CARROT

BY

Suleman UMORU
AGR2100091

DEPARTMENT OF ANIMAL SCIENCE
FACULTY OF AGRICULTURE
UNIVERSITY OF BENIN
BENIN CITY, NIGERIA

NOVEMBER, 2025

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A PROJECT SUBMITTRD TO THE DEPARTMENT OF ANIMAL SCIENCE, FACULTY OF AGRICULTURE, UNIVERSITY OF BENIN, BENIN CITY, IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF A BACHELOR DEGREE OF AGRICULTURE (B.AGRIC.) IN ANIMAL SCIENCE

NOVEMBER, 2025

CERTIFICATION

This is to certify that this project work titled: "**Sensory Evaluation and Proximate Composition of Weaning Food from Maize, Soybean and Carrot**" was carried out by Suleman UMORU with Matriculation Number AGR2100091 of the Department of Animal Science, Faculty of Agriculture, University of Benin, Benin City.

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DR. (MRS) I. IWANEGBE	**DR. N. C. AKAEZE**
(Project Supervisor)	**(Head of Department)**
DATE: _____________________	**DATE:** _________________

DEDICATION

I dedicate this project work to OGHENA for His love and faithfulness all through the course of my programme in the University of Benin. And also to my beloved family for their love, emotional and financial supports.

ACKNOWLEDGEMENTS

I want to appreciate God (OGHENA), whose grace has brought me thus far. "OGHENA OBEKHA".

To my project supervisor, Dr. (Mrs.) I. Iwanegbe, I want to say that I'm grateful for not just being a great supervisor towards me but also for your motherly support. I want to also extend my appreciation to my Head of Department, Dr. N. C. Akaeze and to every other lecturer who has contributed to shaping me in character as well as learning.

I am also grateful to my mother Mrs. Zeberu Ketimu and my siblings for always being there for me. Indeed I wouldn't have been able to achieve this feet without their financial emotional and moral support

To my former roommate Faith, my friends and well wishers I say thank you for always being there whenever I needed your support.

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ABSTRACT

This study evaluated the sensory and proximate composition of weaning food containing maize, soybean and carrot. Maize was fermented and flour was produced. Also, soybean and carrot were processed to flours; blends were produced at different combinations to produce four samples. The blends were produced to form gruel and sensory evaluation was carried out. Proximate evaluation was done. The results for sensory evaluation showed that sample B (4.83 ± 0.37) had the best color quality, this was followed by sample C (4.15 ± 0.80), A (3.67 ± 0.48) and the least was D (3.38 ± 1.19). The results for texture showed that the samples were not different in terms of texture. However, the highest score was sample B (3.84 ± 1.07). The best taste was observed in sample B (4.45 ± 0.52), next was A (3.54 ± 0.52), C (3.31 ± 0.48) and the least was D (2.54 ± 0.86). The overall acceptance was sample B (4.83 ± 0.37) while the least was D (2.54 ± 0.78).The proximate composition was greatly improved for blends with soybean and carrot. The highest ash was sample D (2.53%), fiber sample D (2.16%), fat sample D (23.66%). Sample B (80% maize, 15% soybean and 5% carrot) had the best sensory attributes and was greatly recommended due to its appreciable nutritive contents.

CHAPTER ONE

1.0 INTRODUCTION

Malnutrition is a major health issue in developing countries, contributing to infant mortality, poor physical and intellectual development, decreased resistance to disease, and ultimately stunted development. The pervasiveness of infant malnutrition in the developing world has prompted research, development, and extension efforts by both local and international organizations, leading to the formulation and development of nutritious weaning foods from readily available and local raw materials.

The critical transitional period when children are weaned from liquid to semi-solid or fully adult foods is typically when protein-energy deficiency begins. Due to the growing body's increased nutritional needs during this time, children require calorie-dense, nutritionally balanced supplements in addition to their mother's milk (Sajilata et al., 2002; Umeta et al., 2003). Therefore, weaning food is essential for overall development, according to traditional wisdom on the consumption of protein-rich foods by infants.

In order to meet the nutrient needs of infants in developing countries beyond the basic requirements of protein and energy during the weaning period, it is crucial to incorporate additional sources of calcium, vitamin A and D, iron, and trace elements. This can be achieved through a combination of local staple foods such as cereals, carrots and legumes, which have complementary amino acid profiles that can provide a more complete protein source when consumed together. While cereals are deficient in lysine, a limiting amino acid for human nutrition, they contain sufficient quantities of sulphur containing amino acids that are limited in legumes. (Wang and Daun, 2006; Iqbal et al., 2006; Shewry, 2007).

Whereas maize products in developed countries are primarily utilized for industrial applications and animal feed, in developing countries, the majority of maize products are consumed directly by humans (FAO, 2012). Being the third most cultivated and produced cereal globally, after wheat and rice.

Maize (*Zea mays* L., Poaceae) is a highly significant crop in terms of both agricultural and nutritional aspects, with an average chemical composition of 10.3% protein, 60.5% starch, 1.2% sugar, 2.5% crude fiber and other constituents (Addo-Quaye, Darkwa & Ampiah, 2011). Maize is also abundant in dietary fiber (12.19%), it contains relatively low levels of trace minerals and ascorbate (Hornick & Weiss, 2011). Maize protein content ranges in common varieties from about 8 to 11% of the kernel weight (FAO, 2014). In terms of its protein composition, maize is adequately provided with sulphur-containing amino acids (methionine and cystine), yet it is comparatively deficient in lysine and has an extremely low concentration of tryptophan (Okoh, 2014).

The fermentation of maize presents several benefits, as it facilitates the incorporation of probiotic bacteria into the human digestive system (Kalui, Mathara & Kutima, 2010). Through the natural process of fermentation, the complex sugars and starches found in maize are broken down into more digestible forms, thus rendering fermented maize products more easily assimilable by the human digestive system (Elyas, El Tinay, Yousif & Elsheikh, 2002; Lei, Friis &Michaelsen, 2006). In addition to the aforementioned benefits of fermentation, the process also serves to enhance the bioavailability of vitamins and minerals within the maize, making these nutrients more easily absorbed and utilized by the human body (Towo, Matuschek & Svanberg, 2006). One of the leading ways of using maize is by fermenting it into Ogi/Akamu (a cereal gruel that is often used as complementary food).

Custard can also be produced from maize starch (vanilla flavoured corn starch) which is often given as synergetic food to newborns. The traditional production process of Ogi, a fermented maize product, has been identified as a source of nutrient loss. This disadvantage of the conventional Ogi production process is of particular concern, as it reduces the availability of essential nutrients within the food product, thereby undermining its potential to contribute to optimal nutrition (Obinna-Echem, Kuri & Beal 2014). While traditional production methods of Ogi may be associated with nutrient loss, germination, also known as malting or sprouting, offers a simple and accessible alternative for enhancing the nutritional profile of maize and other grains.

Germination, also referred to as malting or sprouting, involves the hydration and incubation of grains at ambient temperatures, resulting in the initiation of the sprouting process. During germination, both existing (endogenous) and newly synthesized enzymes are activated, leading to a series of biochemical transformations in the grain (Katina, Liukkonen, Kaukovirta-Norja, Adlercreutz, Heinonen, Lampi, Pihlava, & Poutanen, 2007).

Soybean (*Glycine max*), a dicotyledonous legume species native to the regions of East Asia, is cultivated globally for its nutritional and versatile edible bean (Anders, 2013).Soybean, as a leguminous plant, boasts a unique nutritional profile characterized by relatively low carbohydrate content and relatively high protein content, rendering it a valuable dietary source of protein. The soybean's oil and protein together represent approximately 60% of the dry bean's weight, with protein comprising 40% of the dry bean and oil comprising 20%. The remaining 35% of the dry bean is composed of carbohydrates, while the remaining 5% is ash. (Anders, 2013). Carrot (*Daucus carota*) reigns supreme, garnering renown as the most significant crop within this category of flora. Originating as a root vegetable with a global presence, its initial applications were predominantly medicinal in nature, eventually evolving to its present-day status as a widely consumed food item. Historical documents from the European continent indicate that the cultivation of carrots can be traced back to at least the tenth century, highlighting its rich heritage and long-standing cultural significance. (Joao, 2014). Carrots, a root vegetable of remarkable nutritional value, are replete with antioxidant compounds, earning them distinction as the preeminent vegetable source of provitamin A carotenes (Lila, 2004). They are also rich in other phenols (Gonçalves, Pinheiro, Abreu &Silva, 2010).

1.1 OBJECTIVES OF THE STUDY

This project is aimed at assessing the organoleptic properties of enriched weaning food produced from maize, soybeans and carrots in terms of its visual appearance, aroma, taste, texture, and overall acceptability; and to determine the nutritional content of the product through analysis of proximate composition.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 WEANING

In spite of the myriad benefits associated with breastfeeding, several studies have demonstrated that exclusive breastfeeding for more than six months can potentially contribute to increased rates of malnutrition in infants, as breast milk alone is deemed insufficient to meet the evolving nutritional requirements of the infant once they surpass the age of six months (World Health Organization, 30 Nov 2006). According to prevailing health recommendations, it is ideal for an infant to be nourished exclusively on breast milk for the first six months of life, after which complementary feeding, also known as weaning, should be gradually introduced to augment the nutritional needs of the growing infant.

A gradual weaning period from 6 months to 2 years was recommended by WHO (World Health Organization, 2000-2004). This ensures that the infant continues to reap the benefits of breastfeeding while simultaneously obtaining essential nutrients from the varied diet that complements breast milk, thereby supporting optimal growth and development.

Complementary foods are foods other than breast milk or infant formula (liquids, semisolids, and solids) introduced to an infant to provide nutrients (USDA, 2009). Complementary foods for infants comprise of a variety of foods that supplement breast milk, predominantly derived from plant-based sources, such as wheat, maize, rice, roots, tubers, and legumes (e.g. soybeans, cowpeas).

The development of complementary foods for infants often involves the formulation of blends that incorporate multiple plant-based products, such as maize, millet, sorghum, cowpea, groundnut, soybeans, carrots, and other sources of vitamins, with the goal of providing a balanced, nutrient-dense diet for the infant. This can involve the utilization of either a single plant product or a combination of multiple plant products, depending on the desired nutritional profile and the resources available.

Complementary foods must be formulated to provide a high energy density, with a complete profile of essential amino acids, requisite vitamins and minerals, and safe levels of anti-nutritional components, all while maintaining a level of palatability that is acceptable to the infant's developing taste preferences. (Abeshu, Lelisa, & Geleta, 2016). In resource-limited settings such as Nigeria, animal-source foods, while ideal for complementing breast milk due to their superior protein content and bioavailable micronutrients, are often not accessible or affordable. Consequently, local alternatives, such as maize or millet in combination with soybean or groundnut, are commonly utilized in the preparation of infant complementary foods. However, these cereals are deficient in certain amino acids, such as lysine and methionine, which can be remedied by incorporating legumes like soybean into the mix. This approach seeks to optimize nutrient intake for the infant, given the constraints of the local

2.2 IMPORTANCE OF WEANING FOOD

The introduction of nutrient-dense weaning foods during the critical period between 6 and 24 months plays a pivotal role in the nutritional and developmental trajectory of infants, as it supplements breast milk and provides critical nutrients necessary for growth and development. The importance of weaning foods includes;

- Nutritional Needs: Breast After the sixth month, breast milk alone cannot fully satisfy the multifaceted nutrient requirements of infants, necessitating the incorporation of nutrient-rich weaning foods. These foods provide crucial micronutrients, such as iron, zinc, and vitamins, which are not adequately represented in breast milk. They help prevent micronutrient malnutrition.
- Promoting Growth and Development: Physical growth and development, especially during the period of rapid growth is greatly supported by weaning food. They contribute to the development of the digestive system and the ability to handle different food textures.
- Establishing Healthy Eating Habits: The process of weaning serves as a critical period for the development of healthy food preferences and eating habits. By introducing a wide range of foods during this period, infants can establish a broad palate, reducing the risk of food aversions and laying the foundation for lifelong healthy eating habits.
- Addressing Nutrient Deficiencies: In regions with high rates of malnutrition, nutrient-dense weaning foods can play an integral role in addressing potential nutrient deficiencies, ensuring that infants receive adequate levels of essential

vitamins and minerals. Furthermore, the fortification of these foods with additional nutrients can enhance their nutritional value and address nutritional gaps.

- Local Availability and Cost: Local weaning foods, which often incorporate cereals and legumes, offer a viable solution for addressing infant nutrition in developing countries. These foods are frequently inexpensive and easily accessible, ensuring that infants receive adequate nutrition while also promoting the sustainability of local food systems.

2.3 MAIZE

Maize is used as the main plant for the production of industrial products and for feeding animals. It is also the basic nutrition for humans.

Maize is an excellent source of minerals, dietary fibres and vitamins. Due to the presence of high amount of carbohydrates, it is an excellent source of energy and calories. Maize contain many vitamins such as vitamin A, thiamine (vitamin B1), riboflavin (vitamin B2), vitamin C, vitamin E, vitamin K, folate, niacin, pantothenic acid and also have minerals like calcium, zinc, potassium, iron, selenium, and phosphorous. Maize oil is a good source of tocopherols with γ-tocopherol (R.A. Moreau, 2011).

2.4 USES OF CORN

Corn is especially used to prepare traditionally value added products such as infant food, snacks, baked products etc. Chemicals such as ethanol and refined corn oil, starch, or industrial products like candies, cake mixtures, carbonated beverage, sorbitol and cosmetics are also prepared by the corn and corn is also used in the form of corn syrup or corn flakes (Yadav and Supriya, 2014).

2.5 NUTRITIONAL COMPOSITION OF MAIZE FLOUR

Table 1: Nutritional Composition of Maize Flour (per 100 g, dry basis)

Nutrients	Amount (%)
Moisture	11.2
Protein	8.6
Fat	4.5
Ash	1.2
Carbohydrates	74.7
Fibre	2.1

Source: Qamar *et al.* (2017)

2.6 SOYBEAN

Soybean is among the major industrial and food crops grown in every continent. The crop has proven to be a highly adaptable crop, capable of thriving in numerous Nigerian states despite requiring minimal agricultural input. This expansion can be largely attributed to its acclaimed nutritional profile, its various domestic applications, and its burgeoning economic importance (Omoigui *et al*, 2020). Also it is an optimum source of vegetable oil in the international market (Omoigui *et al*, 2020). The seeds are a rich source of oil, accounting for approximately 20% of the seed's dry weight. This oil is notably high in unsaturated fatty acids and free of cholesterol, with approximately 85% of the fatty acids being unsaturated (Omoigui *et al*, 2020). Soybean boasts an impressive average protein content of 40%, surpassing the protein content of other common vegetable or animal food sources found in Nigeria (Omoigui *et al*, 2020).

In the last two decades, the protein derived from soybean has assumed a more prominent position in human nutrition, garnering recognition for its nutritional attributes in both developing and industrialized regions worldwide. The nutritional composition of soybean protein is noteworthy, with 37.69% protein, 28.2% crude fat, 16.3% carbohydrates, 8.07% moisture, 5.44% fiber, and 4.29% ash (Ogbemudia Ruth Etiosa et al., 2018).

Over the years, a substantial body of scientific and clinical research has revealed that many of the constituents of soybean possess health-promoting properties, lending credence to the idea that soybean may serve as a valuable tool in combatting the so-called "lifestyle-related" diseases. The effect of most of the nutritionally and physiologically functional components of soybean (Sugano. *et al*. 2006) are as shown below:

- α- Linolenic acid: Essential fatty acid, hypotriglyceridaemic, improves heart health
- Isoflavones' Estrogenic, hypocholesteraemia, improves digestive tract function, prevents breast cancer, colon cancer, bone health, improve lipid metabolism
- Lecithin: Improve lipid metabolism, improve memory and learning abilities
- Lectins: Anti-carcinogenic, immunostimulatory

- Linoleic acid: Essential fatty acid, hypocholesteraemia
- Peptides' Readily absorbed, reduce body fat, anticancer
- Phytosterols: Hypocholesteraemia, improves prostate cancer
- Protein: Hypocholesteraemia, antiatherogenic, reduces body fat
- Saponin: Regulates lipid metabolism, antioxidant

Additionally, the utilization of soybean plays a vital role in bolstering child nutrition. Studies have established a correlation between soybean intake during childhood and a reduced risk of breast cancer later in life, emphasizing the pivotal role that early soybean consumption can play in shaping health outcomes. Soy products are a rich source of essential nutrients such as calcium, zinc, iron, and folate, which are crucial for growth and development in children. Soy also contributes to dietary fiber intake, an element frequently lacking in children's diets. When paired with cereal grains, soy protein enhances the overall protein quality and quantity in cereal-based products. Soy's cost-effectiveness further solidifies its suitability for school food programs, restaurants, and budget-conscious families alike. Parents frequently react positively to seeing soy listed on product labels, as they often associate soy-containing foods with a nutritious, wholesome choice for their children. Low-calorie, nutrient-dense soy foods can help reduce malnutrition and combat the obesity epidemic.

Studies have highlighted that mothers play a pivotal role in determining the frequency of soybean product consumption within the family, as children's food preferences are greatly influenced by their mother's eating habits (Osera, Tsutie, Kobayashi, Kurihara 2012; Osera, Tsutie, Kobayashi, Segawa, Kurihara 2016). Hence, consuming soybean products from early childhood may have positive health effects for children. Childhood malnutrition, often conflated with undernutrition, is a prevalent global issue, resulting in both short- and long-term detrimental health outcomes. Stunted growth, which may be associated with cognitive development delays, underweight, and wasting, is a common manifestation of malnutrition in children (Wikipedia the free encyclopaedia, 2017). In assessing malnutrition among children under the age of five, several anthropometric indicators are typically employed, with stunting, wasting, and underweight being among the most frequently used. Underweight (low weight-for-age) reflects both low height-for-age and low weight-for-age and therefore reflects both cumulative and acute exposures of malnutrition (Janevic, Petrovic, Bjelic and Kubera, 2010 cited in Bantamen, Belaynew and Dube, 2014).

According to a report by the World Health Organisation, malnutrition remains a leading cause of child mortality globally, with estimates suggesting that 54% of child deaths can be attributed to malnutrition. Childhood underweight, specifically, has been identified as a critical factor in 35% of all deaths among children under the age of five worldwide (Walker, 2008 and Prüss-Üstün, 2008). You et al. (2012) cited in John, Zacharia and James (2015) reported that in 2011, the United Nations estimated 6.9 million deaths of under-five children and mortality rates are concentrated in Sub-Saharan Africa. The nutritional status of children during the early years of development (5 years and below), has been found to be highly dependent on the nutritional status of their mothers during pregnancy and breastfeeding (Wikipedia the free encyclopedia, 2017). In light of evidence indicating that soybean consumption by mothers and children can contribute to improved nutritional status, this study set out to evaluate the utilization of soybean products and the subsequent child nutritional status within households that either produce or do not produce soybeans in the study area. Given that soybean is a rich source of high-quality, inexpensive protein and oil, its contribution to the enhancement of child nutritional status is of paramount importance for consideration (Niyibituronsa, Kyallo, Mugo and Gaidashova, 2014).

2.7 NUTRITIONAL COMPOSITION OF SOYBEAN

Table 2: Nutritional Composition of Soybean Flour (per 100 g, dry basis)

Nutrients	Amount (%)
Moisture	8.2
Protein	38.5
Fat	18.5
Ash	5.2
Carbohydrates	29.6
Fibre	3.5

Source: Achi and Okaka (1999)

2.8 CARROT

Carrot (Daucus carota L.) is the crop of utmost importance in Apiaceae family. Originating as a root vegetable with a global presence, the carrot's history is rooted in its traditional use for medicinal purposes, which eventually expanded to include culinary applications. European records dating as far back as the 10th century document the cultivation of carrots, initially in yellow and purple varieties. It wasn't until the 15th and 16th centuries that the now-prevalent orange carrot made its appearance in Central Europe, becoming the dominant cultivar.This history of selective breeding and development showcases the versatility of the carrot as a crop that has adapted to changing tastes and needs over centuries. The nutritional content of beta-carotene in orange carrots accelerated their popularity in Central Europe, where the identification of this provitamin A marked a turning point in the history of the vegetable (Simon, 2000).

The color pigments in carrots, namely carotenoids and anthocyanins, not only add visual appeal but also confer a range of health benefits due to their antioxidant properties. The type of pigment present determines the color of different carrot cultivars, with carotenoids responsible for the yellow, orange, and red hues in most yellow and orange varieties. The popular orange carrot is especially rich in alpha- and beta-carotene, with a high concentration of provitamin A that contributes significantly to its nutritional profile. The yellow coloration of certain carrot cultivars can be attributed to the presence of lutein, a carotenoid with substantial antioxidant properties (Dias, 2012).

Carrots have been ranked 10th in nutritional value among 39 fruits and vegetables (Acharya, Mishra, Patro and Panda, 2008). Carrot is a good source of dietary fiber and of the trace mineral molybdenum, rarely found in many vegetables. Molybdenum, a trace mineral found in carrots, is critical in regulating the metabolism of fats and carbohydrates, as well as aiding in the absorption of iron. Carrots also contain significant amounts of magnesium and manganese, which perform numerous essential functions in the body. Magnesium, in particular, is required for bone health, protein synthesis, cellular regeneration, B vitamin activation, nervous and muscular system relaxation, blood clotting, and energy production (Guerrera, Volpe and Mao, 2009). Magnesium is also required for Insulin secretion and function (Bartlett, and Eperjesi, 2008) and (Kim, Xun, Liu, Loria, Yokota, Jacobs and He 2010). Manganese is aids in carbohydrate metabolism and in coordination with enzymes in the body (Dias, 2012). Manganese, a mineral found in carrots, serves as an integral cofactor for superoxide dismutase, an antioxidant enzyme that helps protect the body from damage caused by free radicals. Potassium and magnesium, also present in carrots, are essential for maintaining optimal muscular function. In the agricultural context, the exposure of carrot roots to cold temperatures after the juvenile stage, for a duration specific to different cultivars, leads to flower induction and seedstalk formation, a process known as vernalization. The carrot seeds, rich in essential oils, not only have the potential to propagate the plant but also exhibit health-promoting properties.

Below are some health benefits of carrots:

2.8.1 The Antioxidant, Anticarcinogen, and Immunoenhancer Power of Carrots

Like many other colored vegetables carrot is a gold mine of antioxidants. Carotenoids, polyphenols and vitamins present in carrot act as antioxidants, anticarcinogens, and immunoenhancers. Carotenoids widely distributed in orange carrots are potent antioxidants which can neutralize the effect of free radicals. They have been shown to have inhibition mutagenesis activity contributing to decrease risk of some cancers (Dias, 2012) and (Dias, 2012). It was also reported that flavonoids and phenolic derivates, present in carrot roots play also an important role as antioxidants (Zhang and Hamauzuet, 2004). They also exert anticarcinogenic activities, reduce inflammatory insult, and modulate immune response (Dias, 2012).

2.8.2 The Hepatoprotective and Renoprotective Capacities of Carrots

Bishayee et al (1995), observed that carrot extract help to protect liver from acute injury by the toxic effects of environmental chemicals. In its study the effect of carrot extract on carbon tetrachloride (CC14)-induced acute liver damage in mouse was evaluated. The increased serum enzyme levels by CC14-induction were significantly lowered due to pre-treatment with the carrot extract. The carrot extract also decreased the elevated serum bilirubin and urea content due to CC14 administration. Increased activities of hepatic 5'-nucleotidase, acid phosphatase, acid ribonuclease and decreased levels of succinic dehydrogenase, glucose-6-phosphatase and cytochrome P-450 produced by CCl4 were reversed by the carrot extract in a dose-responsive way. The investigators concluded that results of this study revealed that carrot could afford a significant protective action in the alleviation of CCl4-induced hepatocellular acute injury.

Mills *et al*. (2008) measured the possible effects of bioactive compounds in 4 biofortified flesh carrot cultivars (purple/orange, purple/orange/red, orange/red, and orange) on the provitamin A bioefficacy and antioxidant potential on the liver of Mongolian gerbils. Following a 4-wk vitamin A depletion period and baseline kill, freeze-dried carrot powders were mixed into purified feeds and fed to 6 groups of 11 Mongolian gerbils for 4 wk. White flesh carrot fed control and vitamin A supplemented groups were used to calculate carrot provitamin A bioefficacy. Antioxidant potential of carrot powders, sera, and livers were determined using the 2, 2’-azinobis-(3-ethylbenzothiazoline-6-sulfonic acid) radical cation decolorization assay and carotenoid and retinol concentrations were determined by HPLC. The authors observed that the antioxidant potential of the liver and vitamin A stores were greater in Mongolian gerbils fed with colored flesh carrots compared with the control gerbils fed with white flesh carrots and vitamin A supplemented groups.

The renoprotective activity of carrot root extract on renal ischemia reperfusion acute injury in rats (Mital et al, 2011). Rats with renal reperfusion injury showed significantly decreased activity of superoxide dismutase, catalase and glutathione, and a significant increase in malondialdehyde level. The study revealed that carrot extract exerts renoprotective activity against ischemia reperfusion induced kidney acute injury, by reducing free radical scavenging activity one of the mechanisms behind ischemia reperfusion damage of kidneys.

2.8.3 Wound Healing Capability Of Carrots

Animals treated with topical cream of ethanolic extract of carrot root, formulated at different concentrations, showed significant decreases in wound area, epithelization period and scar width when compared to control group animals in an excision wound model (Patil *et al.,* 2012). Meanwhile, rate of wound contraction significantly increased. Moreover, there were also significant increases in wound tensile strength, hydroxyproline content and protein content in animals treated with the topical cream formulation of ethanolic extract of carrot seeds. The antioxidant and anti-microbial activities of ethanolic extract of carrot root, mainly flavonoids and phenolic derivates, may be involved in this increased curative property. Wound healing effects may also be due to regulation of collagen expression and inhibition of elevated levels of lipid peroxides.

2.9 NUTRITIONAL COMPOSITION OF CARROT

Table 3: Nutritional Composition of Carrot Flour (per 100 g, dry basis)

Nutrients	Amount (%)
Moisture	7.2
Protein	6.6
Fat	0.6
Ash	3.7
Carbohydrates	81.9
Fibre	5.3

Source: Oboh (2005)

2.10 SENSORY EVALUATION

Sensory evaluation, also known as sensory analysis, refers to the scientific process of assessing and measuring the sensory properties of a product, such as its appearance, texture, taste, and smell. This method is widely used in various fields, including food and beverage, pharmaceuticals, and consumer goods, to gain a deeper understanding of how consumers perceive and respond to a product.

The core principles of sensory evaluation involve a systematic approach to gathering data from human participants, who provide feedback on the sensory characteristics of a product. This data is then analyzed to identify patterns and trends, which can be used to improve the product's overall quality and appeal.

2.11 CHARACTERISTIC SENSORY EVALUATION

Colour Identification

Color is an important aspect of sensory evaluation in weaning foods, as it can significantly impact a child's acceptance and consumption of different foods. Young children tend to have a preference for bright, vivid colors, and their food choices can be heavily influenced by the visual appeal of a dish. In the context of weaning foods, it is critical to ensure that the color of the food is appealing and inviting, as this can help promote positive food experiences and encourage the development of a diverse palate.

Taste

It determines whether infants and young children find the food palatable and appealing. Taste is influenced by factors such as sweetness, saltiness, bitterness, sourness, and umami (savory taste), and these factors can significantly impact the acceptance of a particular food. In the context of weaning foods, it is essential to create flavors that are enjoyable for infants and young children, while still promoting healthy eating habits.

Texture

This is a crucial element in sensory evaluation of weaning foods, as the consistency and mouthfeel of a food can greatly impact an infant or young child's acceptance and consumption of that food. As children progress through different stages of development, their ability to process and swallow different textures changes, and thus, it is important to provide a range of textures in weaning foods to support their growth and development

Aroma

In general, aroma plays a significant role in sensory evaluation as it can affect consumer preferences, acceptance, and overall experience with a product. Aroma is composed of volatile organic compounds that are released when a product is handled, consumed, or cooked.

Juiciness

juiciness is an essential parameter for sensory evaluation, as it contributes to the overall mouthfeel and texture of the food. For infants and young children, foods that are appropriately juicy can be easier to chew and swallow, which is particularly important during the early stages of eating solids. Moreover, the juiciness of a food can also influence the perception of its flavor, as the release of moisture and flavor compounds can enhance the sensory experience.

Overall acceptability

This reflects the overall opinion of the infant or young child towards a particular food. This evaluation considers a range of factors, such as appearance, aroma, texture, taste, and perceived healthfulness, to provide a holistic assessment of the food's acceptability.

2.12 PROXIMATE ANALYSIS

Proximate analysis is a fundamental method for assessing the chemical composition of organic samples, such as food ingredients, feed, and fuel mixtures. By breaking down the sample into its smaller constituents, such as moisture, ash, protein, fat, and fiber, proximate analysis enables scientists and researchers to gain valuable insights into the makeup and properties of the sample. These data points can inform decision-making in various areas, including food science, nutrition, animal husbandry, and energy production.

In the context of weaning food, proximate analysis plays a crucial role in determining the nutritional profile and quality of various food ingredients used in infant and toddler foods. Proximate analysis provides key information on the macronutrient content (such as protein, fat, and carbohydrates), micronutrient levels (such as vitamins and minerals), and other important nutritional factors (like fiber and water content) that are essential for the growth and development of young children.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 SITE OF STUDY

All practical and experiments were carried out at Department of Food Science and Nutrition, laboratory and Faculty of Agriculture General Laboratory in the University of Benin

3.2 SOURCES OF EXPERIMENTAL MATERIALS

The maize were bought from Uselu market, Benin city. The soybeans were purchased from Uselu market, Benin City. The carrots were purchased from Oba market

3.3 PROCESSING OF EXPERIMENTAL PRODUCE

3.3.1 Maize processing

The method used was according to Iwanegbe, (2021). Three (3) kilogram of maize was prepared by the traditional wet milling process. During this process, the maize was sorted, washed and steeped in sufficient water at room temperature for 72 hours. The water for steeping was changed daily and on the 3rd day, it was drained and wet milled with a disc attrition mill. A muslin cloth was used to sieve the wet milled slurry.

The slurry was allowed to settle overnight and the supernatant decanted. The wet cake was recovered by squeezing excess water with muslin cloth and sun-dried for three days.

It was later dried in a cabinet drier at 50ºC for 8 hours. The meal was further dried and milled in a hammer mill and sieved. The fermented maize flour was packaged in an airtight container for product formulation.

3.3.2 Preparation of Carrot Powder

Carrot Powder was prepared according to the method described by Gazalli, *et al.,* (2013). One kilogram of carrot was washed with distilled water to remove extraneous materials and cut into slices before grating. The grated carrot was spread evenly on trays and dried in an oven at 40°C. The dried carrot was removed from oven when constant weight was attained. Dried carrot was milled (using a blender) to form powder and stored in air tight food grade plastic containers.

3.3.3 Preparation of Soybean Flour

Soybean flour was produced using the method described by Ihekoronye, (1985) with slight modification. 3Kg of soybean seeds was manually sorted, roasted and manually dehulled. The roasted seeds were milled (using a dried milling machine) to form flour and made to pass through 150 µm mesh sieve. The soybean flour was packaged in an air tight container for further analysis.

3.4 PREPARATION OF GRUEL AND SENSORY EVALUATION

Formulated weaning meals was produced by adding hot water to the blends to form gruel and a panel of 15 students evaluated the product using a 5-point Hedonic scale, with score ranging from Like extremely (5) to dislike extremely (1). The evaluated parameters were Colour, texture, taste, mouth feel, and overall acceptability.

3.5 PROXIMATE COMPOSITION

Proximate analyses was carried out on the samples using standard (AOAC, 2005) methods.

3.5.1 Moisture

Moisture content was calculated after drying at 105^{o}C to constant weight in an air oven (Thermo Scientific-UT 6200, Germany).

3.5.2 Protein

Determination of protein was by Kjeldahl method. The efficiency of the nitrogen values were corrected with acetanilide values and multiplied by the factor of 6.25 to obtain the protein value.

3.5.3 Fat

Lipids were estimated by exhaustive extraction of known weight of samples with petroleum ether using rapid Soxhlet extraction apparatus (Gerhardt Soxtherm SE- 416, Germany).

3.5.4 Ash

Ash was determined gravimetrically after incineration in a muffle furnace (Carbolite AAF-11/18, UK) for 24h at 550^{o}C.

3.5.5 Crude fibre

Crude fibre was obtained by difference after the incineration of the ash-less filter paper containing the insoluble materials from the hydrolysis and washing of moisture free defatted sample (0.5 g).

Carbohydrate content was determined by difference: 100% - (% MC + % Ash + % Crude protein + % Fat + % Crude fibre).

3.8 STATISTICAL ANALYSIS

Data generated were subjected to one-way analysis of Variance (ANOVA) in randomized block to test significant variations ($P<0.05$) among mean values obtained. Using SPSS IBM statistical software and origin 2021 to draw bar charts.

Where significant differences existed Duncan's multiple range test was applied to indicate where the differences occurred.

Table 4: Formulation of blends from fermented maize flour, roasted soybean flour and carrot powder.

Sample	Maize (%)	Soybeans (%)	Carrots (%)
A	100	0	0
B	80	15	5
C	60	30	10
D	50	35	15

CHAPTER FOUR

4.0 RESULTS

4.1 SENSORY EVALUATION OF WEANING FOOD

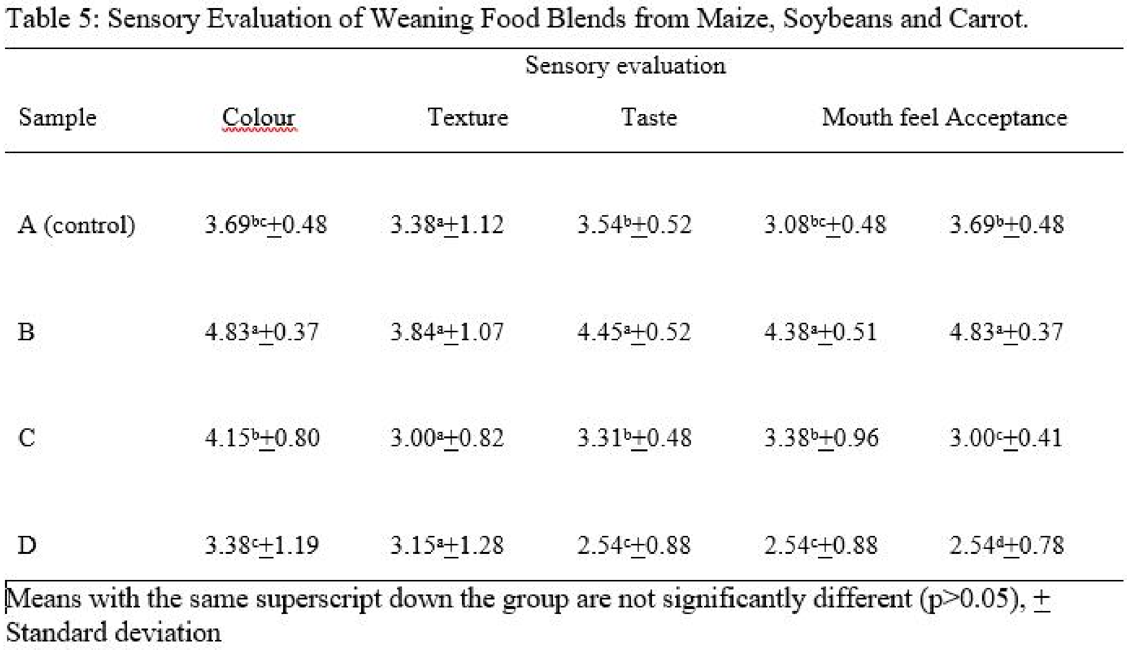

Table 5: Sensory Evaluation of Weaning Food Blends from Maize, Soybeans and Carrot.

	Sensory evaluation				
Sample	Colour	Texture	Taste	Mouth feel	Acceptance
A (control)	$3.69^{bc}\pm0.48$	$3.38^{a}\pm1.12$	$3.54^{b}\pm0.52$	$3.08^{bc}\pm0.48$	$3.69^{b}\pm0.48$
B	$4.83^{a}\pm0.37$	$3.84^{a}\pm1.07$	$4.45^{a}\pm0.52$	$4.38^{a}\pm0.51$	$4.83^{a}\pm0.37$
C	$4.15^{b}\pm0.80$	$3.00^{a}\pm0.82$	$3.31^{b}\pm0.48$	$3.38^{b}\pm0.96$	$3.00^{c}\pm0.41$
D	$3.38^{c}\pm1.19$	$3.15^{a}\pm1.28$	$2.54^{c}\pm0.88$	$2.54^{c}\pm0.88$	$2.54^{d}\pm0.78$

Means with the same superscript down the group are not significantly different (p>0.05), ± Standard deviation

Sample A = 100% Maize, 0% soybean and 0% carrot
Sample B = 80% maize, 15% soybean and 5% carrot
Sample C = 60% maize, 30% soybean and 10% carrot
Sample D = 50% maize, 35% soybean and 15% carrot

The range for the colour score was between 3.38+1.19 - 4.83+0.37. Sample B (4.83+0.37) had the best colour quality. It was followed by sample B (4.15+0.80), sample A (3.69+0.48). Sample D (3.38±1.19) had the least score for colour quality.

The range for the texture scores was from 3.00+0.82 - 3.84a+1.07. Sample D (3.15+1.28) had the lowest texture score, followed by sample D (3.15+1.28). Sample C (3.84a+1.07) had the best texture score, followed by sample A (3.38±1.12).

The values obtained for taste varried from 2.14±0.88 - 4.45±0.52. Sample B (4.45 ± 0.51) had the highest score for taste, followed by sample A (3.54±0.52), sample C (3.31±0.48) and sample D (2.54±0.88).

The mouth feel scores ranged from 2.54±0.88 - 4.38±0.5. The highest mouth feel scores was recorded in Sample B (4.38±0.51). Followed by Sample C (3.38±0.96) and sample A (3.08bc+0.48) while Sample D (2.54±0.88) was the lowest.

The acceptance range from 2.54±0.78 - 4.83±0.37. The most accepted was sample B 4.83±0.37, followed by sample A (3.69±0.48), sample 3.00±0.41 and sample D (2.54±0.78).

Plate 1: Complementary flour and gruel from maize, soybean and carrot. (a) Flour formulations from maize, soybean and carrot. (b) Flour formulations from maize, soybean and carrot. (c) Flour formulations from maize, soybean and carrot showing consistency

4.2 PROXIMATE COMPOSITION

The moisture content ranges from 7.17% - 8.67%. the highest moisture percentage was recorded in sample B (8.67%), followed closely by sample A (8.50%), Sample C (7.33%) and sample D (7.17%)

The percentage protein ranges from 20.41% - 47%. Sample A (20.41) had the lowest protein. The highest protein percentage was in sample D (42.00%), followed by sample C (37.00%) and sample B (32.37%)

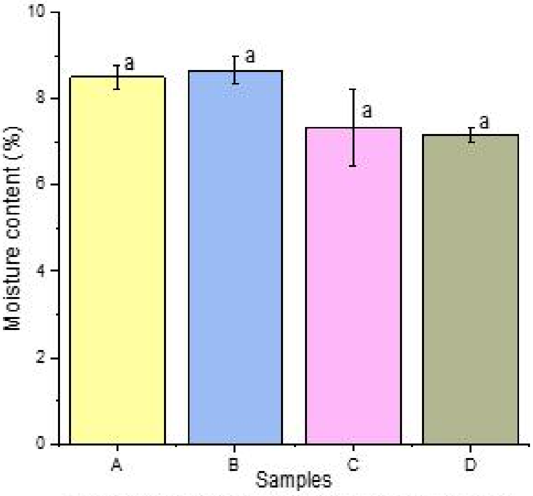

Figure 1; Moisture content of weaning food blends

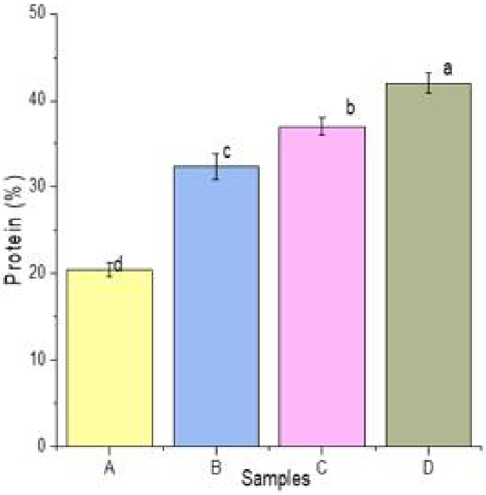

Figure 2; Protein content of weaning food blends

The ash content range was from 0.83% - 2.83%. The highest ash percentage was in sample D (2.83%), followed by sample C (2.17%), sample B (1.17%) and lastly, sample A (0.83%).

The obtained crude fibre values were between 0.50% - 2.17%. The highest value was recorded in sample D (2.17%) and the lowest was in sample B(0.50%). Sample C (1.67%) had the second highest ash percentage, followed by sample A (0.67).

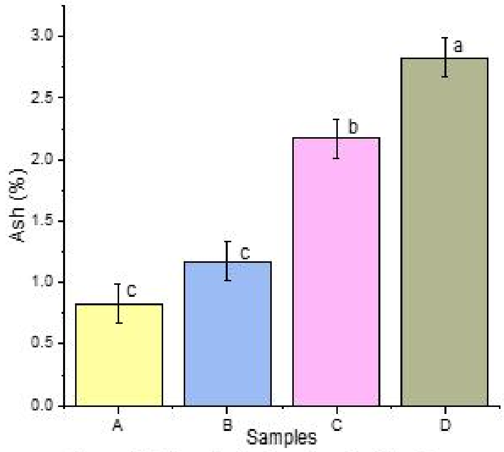

Figure 3: Ash content of weaning food blends

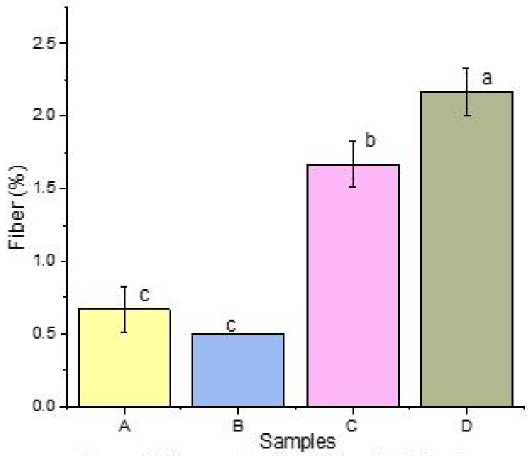

Figure 4:Fiber content of weaning food blends

The fat percentage ranged from 17.33% - 23.67%. Sample D (23.67%) had the highest percentage fat what was followed by sample C (21.33), sample B (19.33) and sample A (17.33).

The percentage carbohydrates varried from 22.17% -51.59%. Sample D (22.17) had the lowest carbohydrates. It was followed by sample C (30.50%) and sample B (37.96). Sample A (51.57%)

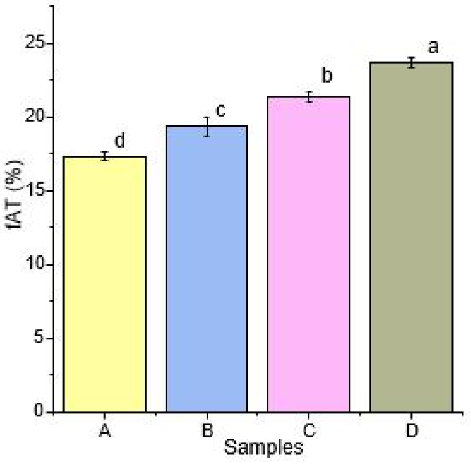

Figure 5: Fat content of weaning food blends

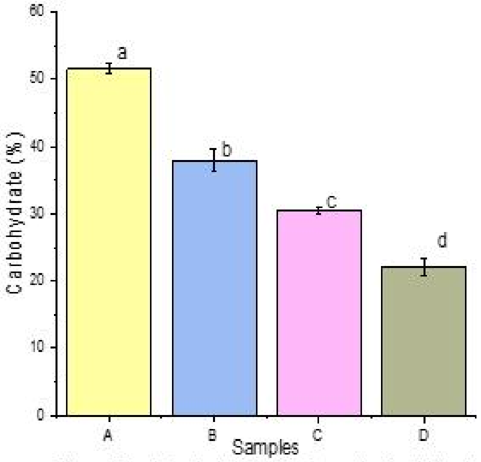

Figure6: Carbohydrate content of weaning food blends

CHAPTER FIVE

5.0 DISCUSSION

5.1 SENSORY EVALUATION

The analysis of variance showed significant differences ($p<0.05$) in the sensory evaluation of the weaning food blends based on treatment applied Table 5.

There was significant difference ($p<0.5$) in the colour quality of the weaning food produced. The best colour was observed in sample B (4.83+0.37) which had 80% maize, 15% soybean and 5% carrot. It was followed by sample C (4.15+0.80) with 60% maize, 30% soybean and 10% carrot. However, this was not significantly different ($p>0.05$) from sample A (3.69+0.48) with 100% maize, 0% soybean and 0% carrot (control). The least colour score was observed in sample D (3.38+1.19) with 50% maize, 35% soybean and 15% carrot but was not significantly different ($p>0.05$) from sample A. it was obvious that the inclusion of carrot to weaning food blends influenced the colour quality. The colour quality of food could be influenced by natural pigments like carotenoids (yellow, orange, red) (Iwanegbe and Owheruo, 2020). Carotenoid give foods an appealing red or yellow colour and improves its quality, it is often divided into two categories; carotenes and xanthophylls. Carotenoids can have a ring of five or six carbons at one or both ends of the molecule, or they can be acyclic (Carle and Schiber, 2001).

There was no significant difference (p>0.05) in the texture of the weaning food blends. However the highest texture score was sample B (3.84+1.07). The non-difference in the texture could be attributed to same amount of moisture and processing methods which likely influence the texture. Processing method like cooking can significantly change a food texture, as well as change its composition, particle size and also it changes in the mouth. Moisture content has a major effect on texture, drying removes moisture, making food rigid while the addition of moisture to weaning flour makes it soft.

The best taste was observed in sample B (4.45+0.52) with 5% carrot inclusion, this results showed that at 15% soybean and 5% level of inclusion of carrot the taste of weaning food is improved positively. The presence of glutamic acid and the buffering effect of free amino acid, blends make carrots taste better than those without. Carrot root contain significant level of thiamin, riboflavin, niacin, folic acid and vitamin C (Bose and Som, 1986). Carrot pomace because of the taste has been used to make high fiber biscuits (Kumari and Grewal, 2007), pickles, cakes, bread, fortified wheat bread and dressing (Filipini, 2001). Next was sample A (3.54+0.52) and C (3.31+0.48) which were not significantly different (p>0.05). The least score for taste was observed in sample D (2.54+0.88), these results showed that at 35% soybean and 15% level of carrot inclusion the taste could be affected negatively.

The mouth feel of food plays a significant role in its perceived flavor. The product with the highest scored mouth feel was sample B (4.38+0.51), this was followed by sample C

(3.38+0.96) and A (3.08+0.48) both were not significantly different (p>0.05). The least score for mouth feel was sample D (2.54+0.88).

The general acceptability of products is influenced by a combination of sensory characteristics, consumer perception and behaviors. The analysis showed that sample B (4.83+0.37) was most accepted and was significantly different (p<0.05) from other products, this was due to it combination of sensory characteristics such as colour, texture, taste and mouth feel. Sample A (3.69+0.48) was rated second best, next was sample C (3.00+0.41) while the least was sample D (2.54+0.78) Table 5.

5.2 PROXIMATE COMPOSITION

The analysis of variance shows there were no significant difference (p>0.05) among the moisture content of weaning food blends. However sample B (8.67%) which had 80% maize, 15% soybean and 5% carrot contained the highest moisture. This was followed by sample A (8.50%) which was 100% maize and sample C (7.33%) which was 60% maize 30% soybeans and 10% carrot. Sample C (6.17%) 50% maize, 35% soybean and 15% carrot had the least moisture (figure 1).

There were significant differences (p<0.05) in the protein content of the weaning food blends with sample D (42.00%) which contains 50% maize, 35% soybeans and 15% carrots which had the highest percentage of crude protein. The soybean flour was reported to have high protein and fat content according to Okoya *et al.* (2006). Sample C (37.00%) which contains 60% maize, 30% soybean and 10% carrots had the second highest percentage of protein due to its relatively higher soybean content as compared to Sample B (32.27%) and Sample A (20.41%). sample A (20.41%) which contained 100% maize had the lowest protein content. Protein content in maize is low because it's a cereal crop (figure 2). Proteins serve as a vital source of amino acids, which are essential for building and maintaining bodily tissues (Olufunso et al., 2019). Additionally, proteins can provide energy when necessary. They also play a crucial role in producing nitrogen-containing compounds, such as antibodies and enzymes, which are vital for maintaining normal bodily functions.

There were no significant differences (P>0.05) in ash content between Sample A (0.83%) and B(1.17%). Sample D (2.83%) had the highest ash content and was followed. by sample C (2.16%). Moreover, there was Significant difference (P<0.05) between Sample D and C. The highest ash content observed in sample D (2.83%) Could be attributed to it highest carrot inclusion (15%) and soybean (35%) in the blends. Achi and окака, (1999) reported that soybean and carrot increases ash content (figure 3). The ash Content for sample A (0.83%) was within the range for maize (0.82 - 1.09%) stated by Qamar et al. (2017),

There was significant difference (P<0.05) in the fiber content of the blends. Sample D (2.16'%) had the highest score, next was Sample C (1.67%). sample B (0.50%) and Sample A (0.67%) were not Significantly different (P>0.05) (Figure 4).

The fat content was significantly different (<0.05) in the blends. Sample A (23.67%) had the highest fat content. Followed by samples C (21.33%), B (19.33%), and A (17.336%). It was observed that as the soybean inclusion increases, the fat content also increased (figure 5). According to Achi and Okaka (1999) soybean is said to contain approximately 18.5% fat.

The carbohydrate was significantly different ($P < 0.05$) in the blends. The highest was sample A (51.59%), next was sample B (37.96%), sample C (30.50%) and the least sample D (22.16%). It was observed that as maize flour reduced in the blends the carbohydrate also reduced. Qamar *et al.* (2017) reported that maize contains approximately 73.4% but the result obtained from this study was a little lower (Figure 6).

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATION

6.1 CONCLUSION

This study showed that composite formulation of weaning food could result in increased sensory attributes such as colour, texture, taste, mouthfeel as well as overall acceptance. Besides, the nutritive compositions of such foods are enhanced. This could help to reduce the problem of malnutrition that is ravaging the developing countries, reduce infant mortality, poor physical and intellectual development, decreased resistance to diseases and ultimately stunted growth/development.

6.2 RECOMMENDATIONS

Based on the findings from this study, I hereby recommend the followings;

1. The use of composite food as weaning food instead of the normal maize flour only as weaning food to reduce malnutrition.
2. The use of soybean as source of protein to increase the protein content, particularly at 15% level of inclusion.
3. The use of carrot which influenced colour particularly at 5% and enhanced the nutritive composition.
4. Fermentation of maize should be practice to enhance sensory attributes and increase nutritive composition.

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APPENDICES

Appendix 1; Raw Data for Sensory Evaluation

Samples	Colour	Texture	Taste	Mouth feel	Acceptance
1	4	5	4	3	4
1	4	4	3	4	3
1	4	4	3	2	4
1	4	2	4	2	4
1	3	2	3	3	3
1	4	5	4	3	4
1	3	4	4	3	4
1	4	2	3	3	4
1	3	3	4	3	4
1	4	3	4	4	4
1	3	2	3	1	3
1	4	4	4	4	4
1	4	4	3	5	3
2	5	5	5	4	5
2	5	2	5	4	5
2	5	5	4	5	5
2	5	2	5	5	5
2	4	4	4	4	4
2	5	3	4	4	5
2	5	4	4	5	4
2	5	5	4	4	5
2	4	4	4	4	5

2	5	4	5	5	5
2	5	4	4	5	5
2	5	3	5	4	5
2	5	5	5	4	5
3	5	3	3	5	3
3	5	3	3	4	4
3	4	2	3	4	3
3	4	2	3	2	3
3	4	4	4	3	3
3	4	2	3	2	3
3	4	2	4	2	3
3	5	3	3	4	3
3	4	4	4	4	3
3	4	4	3	3	3
3	5	4	3	4	3
3	4	3	4	4	3
3	2	3	3	3	2
4	2	2	1	2	2
4	3	2	4	3	3
4	2	2	1	2	2
4	2	3	2	2	3
4	5	5	2	3	2
4	5	5	3	2	2
4	2	1	3	1	2
4	4	4	3	3	4

4	3	3	3	3	3
4	5	4	3	4	2
4	3	4	3	4	4
4	4	4	3	2	2
4	4	2	2	2	2

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
colour * sample	52	100.0%	0	0.0%	52	100.0%
Texture * sample	52	100.0%	0	0.0%	52	100.0%
Taste * sample	52	100.0%	0	0.0%	52	100.0%
Mouthfeel * sample	52	100.0%	0	0.0%	52	100.0%
Acceptance * sample	52	100.0%	0	0.0%	52	100.0%

Report

Sample		colour	Texture	Taste	Mouthfeel	Acceptance
1.00	Mean	3.6923	3.3846	3.5385	3.0769	3.6923
	Std. Deviation	.48038	1.12090	.51887	1.03775	.48038
2.00	Mean	4.8462	3.8462	4.4615	4.3846	4.8462
	Std. Deviation	.37553	1.06819	.51887	.50637	.37553
3.00	Mean	4.1538	3.0000	3.3077	3.3846	3.0000
	Std. Deviation	.80064	.81650	.48038	.96077	.40825

4.00	Mean	3.3846	3.1538	2.5385	2.5385	2.5385
	Std. Deviation	1.19293	1.28103	.87706	.87706	.77625
Total	Mean	4.0192	3.3462	3.4615	3.3462	3.5192
	Std. Deviation	.93914	1.10053	.91740	1.08256	1.01923

ANOVA Table

			Sum of Squares	Df	Mean Square	F	Sig.
colour * sample	Between Groups	(Combined)	15.750	3	5.250	8.621	.000
	Within Groups		29.231	48	.609		
	Total		44.981	51			
Texture * sample	Between Groups	(Combined)	5.308	3	1.769	1.504	.225
	Within Groups		56.462	48	1.176		
	Total		61.769	51			
Taste * sample	Between Groups	(Combined)	24.462	3	8.154	21.200	.000
	Within Groups		18.462	48	.385		
	Total		42.923	51			
Mouthfeel * sample	Between Groups	(Combined)	23.462	3	7.821	10.339	.000
	Within Groups		36.308	48	.756		
	Total		59.769	51			
Acceptance * sample	Between Groups	(Combined)	39.288	3	13.096	45.910	.000
	Within Groups		13.692	48	.285		
	Total		52.981	51			

ANOVA

		Sum of Squares	Df	Mean Square	F	Sig.
Colour	Between Groups	15.750	3	5.250	8.621	.000
	Within Groups	29.231	48	.609		
	Total	44.981	51			
Texture	Between Groups	5.308	3	1.769	1.504	.225
	Within Groups	56.462	48	1.176		
	Total	61.769	51			
Taste	Between Groups	24.462	3	8.154	21.200	.000
	Within Groups	18.462	48	.385		
	Total	42.923	51			
Mouthfeel	Between Groups	23.462	3	7.821	10.339	.000
	Within Groups	36.308	48	.756		
	Total	59.769	51			
Acceptance	Between Groups	39.288	3	13.096	45.910	.000
	Within Groups	13.692	48	.285		
	Total	52.981	51			

Colour

Duncan[a]

Sample	N	Subset for alpha = 0.05		
		1	2	3
4.00	13	3.3846		
1.00	13	3.6923	3.6923	
3.00	13		4.1538	
2.00	13			4.8462
Sig.		.320	.138	1.000

Texture

Duncan[a]

Sample	N	Subset for alpha = 0.05
		1
3.00	13	3.0000
4.00	13	3.1538
1.00	13	3.3846
2.00	13	3.8462
Sig.		.074

Taste

Duncan[a]

Sample	N	Subset for alpha = 0.05		
		1	2	3
4.00	13	2.5385		
3.00	13		3.3077	
1.00	13		3.5385	
2.00	13			4.4615
Sig.		1.000	.348	1.000

Mouthfeel

Duncan[a]

Sample	N	Subset for alpha = 0.05		
		1	2	3
4.00	13	2.5385		
1.00	13	3.0769	3.0769	
3.00	13		3.3846	
2.00	13			4.3846
Sig.		.121	.372	1.000

Acceptance

Duncan[a]

sample	N	Subset for alpha = 0.05			
		1	2	3	4
4.00	13	2.5385			
3.00	13		3.0000		
1.00	13			3.6923	
2.00	13				4.8462
Sig.		1.000	1.000	1.000	1.000

Report

sample		moisture	protein	ash	fiber	fat	Cho
1.00	Mean	8.5000	20.4133	.8333	.6667	17.3333	51.5867
	Std. Deviation	.50000	1.33440	.28868	.28868	.57735	1.44590
	Std. Error of Mean	.28868	.77042	.16667	.16667	.33333	.83479
2.00	Mean	8.6667	32.3733	1.1667	.5000	19.3333	37.9600
	Std. Deviation	.57735	2.62500	.28868	.00000	1.15470	3.04833
	Std. Error of Mean	.33333	1.51555	.16667	.00000	.66667	1.75995
3.00	Mean	7.3333	37.0000	2.1667	1.6667	21.3333	30.5000
	Std. Deviation	1.52753	1.73205	.28868	.28868	.57735	1.00000
	Std. Error of Mean	.88192	1.00000	.16667	.16667	.33333	.57735
4.00	Mean	7.1667	42.0000	2.8333	2.1667	23.6667	22.1667
	Std. Deviation	.28868	2.00000	.28868	.28868	.57735	2.25462
	Std. Error of Mean	.16667	1.15470	.16667	.16667	.33333	1.30171
Total	Mean	7.9167	32.9467	1.7500	1.2500	20.4167	35.5533

	Std. Deviation	1.01876	8.52141	.86603	.75378	2.53909	11.43253
	Std. Error of Mean	.29409	2.45992	.25000	.21760	.73297	3.30029

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
moisture	Between Groups	5.417	3	1.806	2.407	.143
	Within Groups	6.000	8	.750		
	Total	11.417	11			
protein	Between Groups	767.417	3	255.806	65.293	.000
	Within Groups	31.343	8	3.918		
	Total	798.759	11			
ash	Between Groups	7.583	3	2.528	30.333	.000
	Within Groups	.667	8	.083		
	Total	8.250	11			
fiber	Between Groups	5.750	3	1.917	30.667	.000
	Within Groups	.500	8	.063		
	Total	6.250	11			
fat	Between Groups	66.250	3	22.083	37.857	.000
	Within Groups	4.667	8	.583		
	Total	70.917	11			
Cho	Between Groups	1402.797	3	467.599	107.086	.000
	Within Groups	34.933	8	4.367		
	Total	1437.729	11			

moisture

Duncan[a]

sample	N	Subset for alpha = 0.05
		1
4.00	3	7.1667
3.00	3	7.3333
1.00	3	8.5000
2.00	3	8.6667
Sig.		.082

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

protein

Duncan[a]

sample	N	Subset for alpha = 0.05			
		1	2	3	4
1.00	3	20.4133			
2.00	3		32.3733		
3.00	3			37.0000	
4.00	3				42.0000
Sig.		1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

ash

Duncan[a]

sample	N	Subset for alpha = 0.05		
		1	2	3
1.00	3	.8333		
2.00	3	1.1667		
3.00	3		2.1667	
4.00	3			2.8333
Sig.		.195	1.000	1.000

fiber

Duncan[a]

sample	N	Subset for alpha = 0.05		
		1	2	3
2.00	3	.5000		
1.00	3	.6667		
3.00	3		1.6667	
4.00	3			2.1667
Sig.		.438	1.000	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

fat

Duncan[a]

sample	N	Subset for alpha = 0.05			
		1	2	3	4
1.00	3	17.3333			
2.00	3		19.3333		
3.00	3			21.3333	
4.00	3				23.6667
Sig.		1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Cho

Duncan[a]

sample	N	Subset for alpha = 0.05			
		1	2	3	4
4.00	3	22.1667			
3.00	3		30.5000		
2.00	3			37.9600	
1.00	3				51.5867
Sig.		1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.