Wolkite University

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College of Engineering and Technology

Department of Food Process Engineering

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List of Acronyms and Abbreviations

AOAC	Association of Analytical Chemists
CFU	Colony Forming Unit
FAO	Food and Agriculture Organization
GI	Gastrointestinal
PEM	Protein Energy Malnutrition
WHC	Water Holding Capacity
WHO	World Health Organization

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Abstract

Supplementary food is any food other than breast milk given in the supplementary feeding period. supplementary foods can be prepared specially for infant or can be the same foods available for family members, modified in order to meet the eating skills and needs of the infant. develop and evaluate supplementary food for infants from blends of maize flour with soybean flour. Sample collection maize and soybean were collected from local market that used for production of infant production of infant food made or produced from the proportion of from maize flour and soybean flour. mixture design was used to find high and low value of blended maize and soybean. composite flours as 63%: 37%: (A1), 60%: 40%: (A2), 65%: 35%:(A3), 65%:35%(A4),70%:30% (A5) and 100% (A0) are control. proximate compositions moisture and fat functional properties water adsorption and bulk density sensory quality microbial analysis. The moisture content of the samples ranges from A0 to A5 (6.48±3.8) was not significant difference ($P<0.05$) Fat blende varies from A0(4.5±0.42) and other the fat content of maize lower than soybean because A0 was control or not blended soybean functional properties of the sample A5 (303.35±1.48) was high amount of water absorption capacity then other in order to these result was different blended ratio. sensory of mean scores increase with increase in the proportion of soybean and product samples in all the infant food samples in terms of all the sensory attributes tested. microbial count were low A4B0 in our result concentration increases microbial increase from (10^{0} to 10^{-4}) in generally our product was best.

Key words: Blending Ratio; Infant Food; Maize; Multination; Soy Bean

CHAPTARE ONE

1. Introduction

1.1. Background

Food security remain an unfulfilled dream for more than 800 million people (Combes et al., 1996) who are unable to lead healthy and active lives because they lack access to safe and nutritious food. Anon (2003), reports that the World Health Organization (WHO) called protein energy malnutrition, (PEM), the silent emergency. According to this report, it declared that PEM is an accomplice in at least half of 10.4 million child deaths each year.Complementary food is any food other than breast milk given in the complementary feeding period. Complementary foods can be prepared specially for infant or can be the same foods available for family members, modified in order to meet the eating skills and needs of the infant (Cristina et al., 2004).

The World Health Organization (WHO) and UNICEF have been concerned about this trend, particularly of Protein Energy Malnutrition (PEM) and micronutrient deficiencies (Hidden Hunger) among infants, children and pregnant women. The United Nations' Standing Committee on Nutrition (SCN) pointed out that malnutrition is directly and indirectly associated with more than 50% of all children mortality, is the contributor to disease in developing world SCN (2004).Protein energy malnutrition (PEM) generally occurs during the crucial transitional phase when infant from liquid to semi-solid or fully adult foods. During this period, because of their rapid growth, children need nutritionally balanced, calorie-dense supplementary foods in addition to mother's milk. In Sub-Saharan Africa, extreme poverty, inadequate caring practices for children, low levels of education and poor access to health services are among the major factors causing under nutrition WHO (2000).

Infant malnutrition, underweight and stunting has increased efforts in research, development, and extension by both local and international organizations to improve the energy and protein content of weaning foods specifically primary traditional maize meal only or roasted maize meal only weaning foods which had been attributed to the high prevalence of child malnutrition for infants in Ghana (2011). Provision of adequate and appropriate supplements to young children prevents malnutrition. Foods that are regularly fed to the infant, in addition to breast-milk, providing sufficient nutrients are known as supplementary or complementary foods. These could be liquid like milk or semi- solids in case of infant or solid preparations like rice etc. in the case of children over the age of one year WHO (2002).

Most malnourished people live in Asia and Africa; and the staple of most people in Asia and Africa are starchy pastes. These pastes are made from cereals (sorghum, rice, maize, wheat, millet, acha) roots and tubers (cassava, yam, sweet potato and plantain). These crops do not only provide marginal nutrition (especially for children) but also require high inputs of time, labour and fuel to prepare. In most cases they are consumed as combinations in the home because the blends provide complementary balance of amino acids (proteins) in the diet (FAO, 1985). That Africa and especially sub Saharan Africa is in danger of food shortages is no longer news. What is news however being the inability of this region to rise to the great danger facing this region in terms of provision of adequate food. It was in response to this bleak future that the Bill Gate foundations (2007-2009) sponsored recent research on the possibility of development of drought resistant legumes including soybeans for the areas prone to drought. This was in the realization that these legumes would not only provide needed protein there by improving the nutritional status of the farming populations it would also enhance the socio- economic status of the populace through value chain addition.

Ethiopia is among the most deplorable country in the world, in the area of infant food and has the 6th highest infant mortality rate in the world. Available data shows that, 504,000 children under 5 years old die per year in Ethiopia, and second highest as a proportion of population. This is the equivalent of the famine in 1984-85 before 20 years. Apart from the large number of child deaths, 52% of Ethiopian children suffer from stunting and 11% wasting; resulting from the long term effects of malnutrition, because the child enters the family eating pattern and eats not only small amounts of food, but foods unsuitable for weaning purposes and also ignorance of mothers was the main reason for child malnutrition. The child nutrition remained fairly stable up until the age of 5 months, after that, the nutritional conditions deteriorated, with 40% of children malnourished before the age of 2 years UNICEF (2002).

The soybean with its high protein content and good protein quality is a critical crop that has many potential uses which need to be investigated. In addition to its wide use as animal feed and a source of raw materials for industrial operations, the soybean in some areas of the world is already a protein source of major importance to the human population. Soybeans and products derived from them have played a major role for many centuries. Utilization of soybeans offers potential opportunities for alleviating present and imminent worldwide shortages of food. The nutritive quality of soybean protein is the best of those available from plant sources and is inferior to animal protein only because it is deficient in sulfur-containing amino acids. The whole soybeans may be baked or boiled or used in making sprouts, vegetable milk, fresh and dried tofu (curd prepared from soybean milk), and many fermented products. Baked or boiled soybeans are not very popular in this country or in the Orient, probably because soaking and cooking require long periods, and the product causes flatulence. presoaked soybeans (Hilton et al, 1992; Gill et al, 2001; Wang et al, 2004; Fabian and Elmadfa, 2006). maize are locally produced and this may make the weaning product very affordable. This study was undertaken to developing supplementary food by blending of soyabean.

1.2. Statement of the Problem

Mostly developing countries, the underlying problems have been identified to include poverty, inadequate nutrient intake particularly during pregnancy, period of rapid growth and complementary feeding in older infants, ignorance about nutrient values of foods tuff and parasitic infections therefore infants' intake adequate nutrient Abuja (2002). The demand for protein with balance in essential amino acids is increasing in Ethiopia. However, due to low levels of standards of living, those people may not have an income to buy and eat proteinous foods of animal origin. As a result of this, looking for plant which can supplement a protein identical to animal origin is a crucial. To address these issues, the supplementary foods can be prepared from composite flours such as maize and soybean flour blend. Results of the 2001-2003 food consumption and nutrition survey showed a step increase in the incidence of child wasting between 6 and 12 months, which is the period of supplementary feeding for most children IITA (2004). In Ethiopia, the decreasing of infant food production among childhood population brought malnutrition problem, that is 94 deaths out of every 1000 live birth among infant from less than 2 years old FAO (2006). The poorly fed women in Africans at best can produce approximately 500 to 600ml of milk daily. For ideal growth infant at a weight of 5kg or at age 3 to 4 months require more than 850 ml of breast milk daily. Thus, the infant's nutrient need fail to be met by breast milk alone, resulting in dietary inadequacy Whitehead (1996). However according to this problem increase food production among childhood population brought malnutrition problem to solve.

1.3.Objectives

1.3.1. General Objective

To develop and evaluate supplementary food for infants from blends of maize flour with soybean flour.

1.3.2. Specific objectives

- To evaluate proximate composition of flours and product.
- To evaluate functional and sensory quality of formulated product.
- To assess the microbiological quality of the formulated product.

1.4. Significance the study

This study was a part of exploratory effort on the improvement of the nutritional quality of traditional complementary foods. It was designed to use staple foodstuffs indigenous to formulate composite blends that was nutritious, readily available and affordable to both rural and poor urban mothers. Findings from the study offered answers to the questions.

(a) Whether such blends can meet the various dietary recommendations for older infants and children.

(b) Whether they can substitute the more expensive proprietary formulas sold in the market and
(c) Formulate composite blends using selected cereal (maize), legumes (soybeans).

Therefore, the outcome of this research will be baseline information for consumers, policy makers, researchers and manufacturers.

CHAPTER TWO

2. Literature review

2.1. Malnutrition

The treatment of malnutrition, as well as its prevention, among children under 5 years of age requires consumption of nutritious food, including exclusive breastfeeding for the first 6 months of life, followed by breastfeeding in combination with complementary foods thereafter until at least 24 months of age; a hygienic environment (clean drinking water, sanitary facilities); access to preventive (immunizationitamin A supplementation, etc.) as well as curative health services, and good prenatal care. In this article, the focus is on possible options for providing a nutritious diet, realizing the constraints faced by many people whose children are at risk for developing or confirmed to be suffering from moderate malnutrition (stunting as well as wasting), such as poverty and food insecurity. Although the nutrient density requirements proposed by Golden (2009) are for moderately malnourished children, much of the dietary recommendations and complementary food.

Under nutrition is widespread in the developing countries of the world. Throughout the world it is estimated that four hundred (400) million people suffer from serious nutritional deficiencies Ojofeitimi (1992). Asia, Africa and Latin America have about twenty-five percent to thirty percent (25%-30%) of the population suffering from semi starvation Armar Klemesu and Wheeler (1991). Children are the hardest hit. The poorly nourished child is highly susceptible to infection, and infections are more severe and last longer in malnourished than in a well-nourished child. The child is then more vulnerable to next infectious disease to which he or she is exposed. The annual death fifteen million children under the age of five years. This represents one fourth of the death throughout the world. The growth patterns of a child are useful means for judging nutritional well-being. When a child is poorly nourished, the growth rate diminishes particularly because of delay in bone development Ojofeitimi (1992); Armar (1989). Both the quality of the bone (the amount of calcium and phosphorus it contains) and its capability for growth is influenced by nutrition. Sexual maturity appears to occur late in populations that are malnourished than in developed countries Armar Klemusu and Wheeler (1991).

Every child admitted to the hospital for poor weight gain or malnutrition should be screened for the presence of illnesses and condition that could lead to protein-energy malnutrition. Children with higher-than average risk for malnutrition should be more closely assessed and evaluated often. Children who cannot or will not eat, or who are unable to absorb nutrients taken by mouth, may be fed by the use of tube feeding. Tube feeding is often used to provide nutrients to children who have burns, inflammatory bowel disease, or other long-term conditions, that case chronic malnutrition or malabsorption (e.g. cystic fibrosis or AIDS), and interfere with the ability to take in enough calories. This procedure involves inserting a thin tube through the nose and carefully guiding it along the throat until it reaches the stomach or small intestine FAO/WHO (1998).

If long-term tube feeding is necessary, the tube may be placed directly into the stomach or small intestine through an incision in the abdomen Bennett and Fred Plum (1996). Tube feeding cannot always deliver adequate nutrients to children who: Require surgery, have persistent diarrhoeas' or vomiting and have a gastrointestinal tract that is not functional.

Intravenous feeding can also supply some of the nutrients these children need. Doctors or registered dieticians can help parents monitor overweight or obese children. These professionals may suggest a weight loss program if the child is more than 40 percent overweight. Keeping weight gain under control is accomplished by changing eating habits, lowering fat intake, and increasing physical activity.

Protein Energy Malnutrition (PEM)

The silent emergency of the world" which may have hunted mankind since the dawn of history is by far the most lethal form of malnutrition. It is an imbalance between the supply of energy and protein, and the body's demand for them to ensure optimal growth and function. It is currently the most widespread and serious health problem of children in the world being the moderate or severe forms USAID (2002). This syndrome is one example of the various levels of inadequate protein and/or energy intake between starvation (no food intake) and adequate nourishment. Although infants and children of some developing nations dramatically exemplify this type of malnutrition, it can occur in persons of any age in any country. Inadequate intake of food essential nutrients leads to under nutrition, resulting in deterioration of physical growth and health. On the other hand, excess intake of high-energy food relative to the body's needs results in overweight and obesity. Children under 5 years of age are the most visible victims of PEM and most susceptible to PEM's characteristic growth impairment because of their high energy and protein need and their vulnerability to infection. Protein Energy Malnutrition (PEM) and micronutrient deficiencies among infants, children and pregnant women have been shown to be directly and individual associated with more than 50% of all childhood morbidity and mortality in the developing world SCN (2004).

Prevention of Malnutrition Proper nutrition is required to ensure optimal health. Consumption of a wide variety of food, with adequate vitamin and mineral intake, is the basis of a healthy diet. Researchers have stated that no single nutrient is the key to good health, but optimum nutrition is derived from eating a diverse diet, including a variety of fruits and vegetables. Because foods such as fruits and vegetables provide more nutrients than vitamin supplements, food is the best source for acquiring needed vitamins and minerals FAO/WHO (1998); USAID (2002). Breastfeeding a baby for at least six months is considered the best way to prevent early-childhood malnutrition. The United States Department of Agriculture, Health and human Service recommended that all Americans over the age of two should: Consume plenty of fruits, grains, and vegetables, Eat a variety of foods that are low in fats and cholesterol, and contain only moderate amounts of salt, sugars, and sodium and Engage in moderate physical activity for at least 30 minutes, at least several times a week.

2.2. Nutrition in Infants

Nutrition plays an important role in life even before birth and an infant's nutrition during the first year of life. This is for the growth, development and maturation of body tissues which occur rapidly during the first year of life. A healthy infant's birth weight doubles by about five month of age and triples by one year and thus infants have a higher basal metabolic rate about twice that of adults, based on body weight Whitney (1999).

According to Wardlaw and Insel (2000), an infant typically increase in length by 50% in the first year. Such rapid growth requires both nourishment and sleep in abundance. They also need concentrated source of nutrient and energy to support their tremendous growth and development.

When an infant is inadequately fed there is the risk of stunted growth and a range of biochemical changes that can impair development to the extent of permanently damaging the infant health.

During the first four to six months of life, all nutrients required by an infant can be provided by breast milk and so there's no dietary need for the introduction of solid food before then Trussel (2003). By the age of 6 months, most infant need additional foods, the purpose of which is to complement the breast milk and make certain nutrient that the young child continues to have enough energy and nutrients to grow normally. This goal is only achieved when these foods are prepared and fed to the infants under hygienic conditions and given in adequate proportions. Cereals should be introduced differently a week at a time to identify allergies and for the infant to develop preference Akaninwor (2004).

2.3. Soybean

Soybean is the basis of human diets in many Eastern countries, due to its high nutritional value and low cost. The relationship between soybean intake and human health has been widely investigated due to the nutritional characteristics of this grain, including its high quality protein, significant content of minerals and fibres, small amounts of saturated fat, and absence of cholesterol (Silva et al., 2006). Its protein content (40%) is higher and more economical than that of beef (18%), chicken (20%), fish (18%) and groundnut (23%) IITA (1990). Soybean is also of particular interest as a vegetable protein source because of its cholesterol lowering abilities in patients with type II hypolipoproteinaemia Sirtori et al. (2000).

Apart from proteins, Soybeans also contain carbohydrate (32%), fat (20%), minerals/vitamins (5%) and fiber (3%). A lot of work has been reported on the chemical composition, cultivation and processing of Soybean. Studies on the chemical composition, protein fraction, and is of flavones are of great importance to establish the differences between the characteristics of soybean cultivars and breeding lines. These characteristics are relevant for the consumer market, considering the nutritional value and functional aspects. From the point of view nutritional composition, soybeans contain essential components for human consumption, thus becoming excellent source of protein and lipids. However, the levels of these constituents are influenced by a number of environmental and genetic factors, which may vary according to the crop Bhardwaj et al.,(1999).

Supplementation of soy fibre significantly enhanced return of serum glucose levels towards fasting levels during the latter half of the test meal though soy fibre had no effect on plasma insulin levels. Lactose intolerance means the body cannot digest or absorb the sugar, lactose in milk, other dairy products, and foods to which milk has been added. Because of this, lactose free soy-protein based formula in the management of long-term lactose restriction, a number of studies have addressed the role of these formulas in the recovery of acute infantile diarrhea American Academy of Pediatrics (1998).

There is much evidence from studies on experimental animal and human subjects that substitute soy-protein for animal in the diets reduces the concentration of total and LDL cholesterol in the plasma or serum American Academy of Pediatrics (1998). The suggested importance for lowering cholesterol levels is as follows: It improves the catabolism of cholesterol rich in Low Density Lipoprotein fraction (LDL) and Absorption of lipids from gastrointestinal (GI) tract may be slow with soy protein. It increases billiard cholesterol excretion.

2.3.1. Uses of Soybeans

The uses of soybean are numerous. They are processed to give soy milk, soy sauce, tofu (soybean curd) yogurt, soybean sprout, Tempeh (soy steak), which is extensively used in the Far East as infant feeding. The seed yield edible, semi-drying oil which is extensively used in the Far East as food. The bulk of the oil is used for edible purposes particularly as a salad oil or in the manufacture of margarine, shortening and soy meal. The residues after the extraction of the oil is a very rich protein feeding stuff for livestock and for the manufacture of synthetic fibre, textile sizes and fire fighting foam. Soy flour prepared from whole soybeans is used in bakery and other food product extends to cereal flour, meat products and in health foods. Soybean flour is becoming increasingly important as an ingredient of food stuffs and bakery products such as bread, biscuits and cakes, IITA (1990).

2.3.2. Nutritional Composition of Soybeans

Soya bean is a legume widely grown for its edible bean which has numerous uses. Soybean is becoming popular, it contains 40% food quantity protein, 20% fat, 23% of carbohydrate and reasonable amount of minerals vitamins and is an excellent healthy food. Be a complete protein, it can be useful to fortified food that has limiting amino acid (Purcel et al., 2000). This study was aimed at formulating complementary foods from composite flour from sprouted maize grain, plantain, soybean flour at different substitution levels as well as to evaluate the nutrient and sensory properties of the food blends.

Table2.1. Chemical Composition of Soybean per 100g Edible Portions.

Constituent	Composition/ 100g	Amino acid profile (gram/ 100g protein)	
Moisture	4.90g	Arg	46
Protein	39.80g	His	21
Fat/oil	17g	Iso	56
Ash	4.05g	Leu	79
Fiber	6.70g	Lys	62
Carbohydrate	25g	Met	21
Mineral	7g	Phen	87
Lipid	25.15	Thr	41
		Trp	41
		Val	37

Source: Bhardwaj(1999)

2.4. Maize (*Zea mays*)

The plant (*Zea mays L.*) is a manioc annual plant which belongs to maideas tribe and the grass family of gramineae, and their cells have chromosomes. Maize is the third most important crop after wheat and rice and is grown in more countries than any other crop in the world. It is cultivated virtually in all parts of the world except Antarctica. It has very specific water and climatic requirements in order to thrive. Most importantly, for the plant to germinate it needs a temperature ranging from 15 to 20ºC this plant is the largest grown (785 million tons) cereal in the world with doubled grain yield per unit area compared to wheat and barley. In Turkey, corn is produced on approximately 550 thousand hectares with annual production of 3.5 million tons, of which nearly half is produced in the Mediterranean region. The share of corn production as second crop in the Mediterranean region is very high OZCAN S (2009).

Table2. 2. Proximate Composition of Maize

Constituent	Composition (%)	Amino acid profile (gram/ 100g protein)	
Moisture	6	Arg	38
Protein	10.9	His	24
Fat	4.5	Iso	29
Ash	1.2	Leu	23
Fiber	2.2	Lys	11
Carbohydrate	84	Met	20
Mineral	1.3	Thr	21
		Trp	04
		Val	40
		Phen	42

Source:JEAN DU PLESSIS (2003

2.4.1. Uses of maize

Maize starch plays a leading role in determining the texture of many foods, which is vital to both the consumer and the food manufacturer, as a major factor that governs the acceptability and palatability of most food products. Maize is also used as food and raw material for industrial use. In industrialized countries, a larger proportion of the grain is used as livestock feed and as industrial raw material for food and non-food uses. On the other hand, the bulk of maize produced in developing countries is used as human food, although its use as animal feed is increasing. Maize is the largest food crop of the United States, which is responsible for 40 percent of the world's production Anoumaus (2012).

Maize is the most important raw material for industrial starch. Maize starch is a maize product and it is employed in the manufacture, ceramics, dyes, plastics, oil cloth, paper and paper boards and in textiles, cosmetics, pharmaceutical industries. The derivatives of maize starch include glucose or corn syrup, corn sugar, dextrins and industrial alcohol, which are employed in different industries. Increasingly, ethanol is being used at low concentrations (10% or less) as an additive in gasoline for motor fuels to increase the octane rating. Lower pollutants and reduce petroleum use WATSON (1994).

Corn cobs are also used as a biomass fuel source. In Canada and the U.S these are called “corn mazes” and are popular in many farming communities. Maize is sometimes used as biomass fuel, such as ethanol. Maize is also used as fish bait. It is particularly popular in Europe for coarse fishing. Stigmas from female corn flowers, known popularly as corn silk, are sold as herbal supplements Doebley (1994).

CHAPTER THREE

3. Materials and Methods

3.1. Experimental site

The experiment was conducted at Wolkite University Food Process Engineering Laboratory.

3.2. Sample collection

The (*Zea mays* L.) maize and soybean were collected from local market that used for production of infant food.

3.3 . Equipment, Chemicals and reagents

The equipment's used for this thesis were roaster, sun drier, miller, sieve, Oven, hot plate, thimble, incubator, backer, taste tube, Petri dish, fat extractor, filter paper, cotton, flask, autoclave, and sox let. The chemicals and reagents hexane, petroleum ether, and di-ethyl ether.

3.4. Methods

3.4.1. Preparation of supplementary infant food.

Sample was prepared according to Armar Klemesu and Wheele (1991). Soybeans were washed and soaked in water for a day. Defective grain (with holes), stones, dried pods and other debris was removed by the nylon sieve and allowed to drain. It was then lowered into a container containing already boiled water for about 20 minutes. The water was drained off and discarded. The DE hulled beans were then solar dried after which it was roasted at 190 ^{0}C using an electric oven to further reduce to improve upon the flavour of the final product. The roasted soybeans were milled into flour to obtain smooth and consistent particle sizes of 180µm. The cereals maize was separately washed with tap water and air-dried for 12 hours. The cereals were roasted at 190^{0}c for 30 minutes.

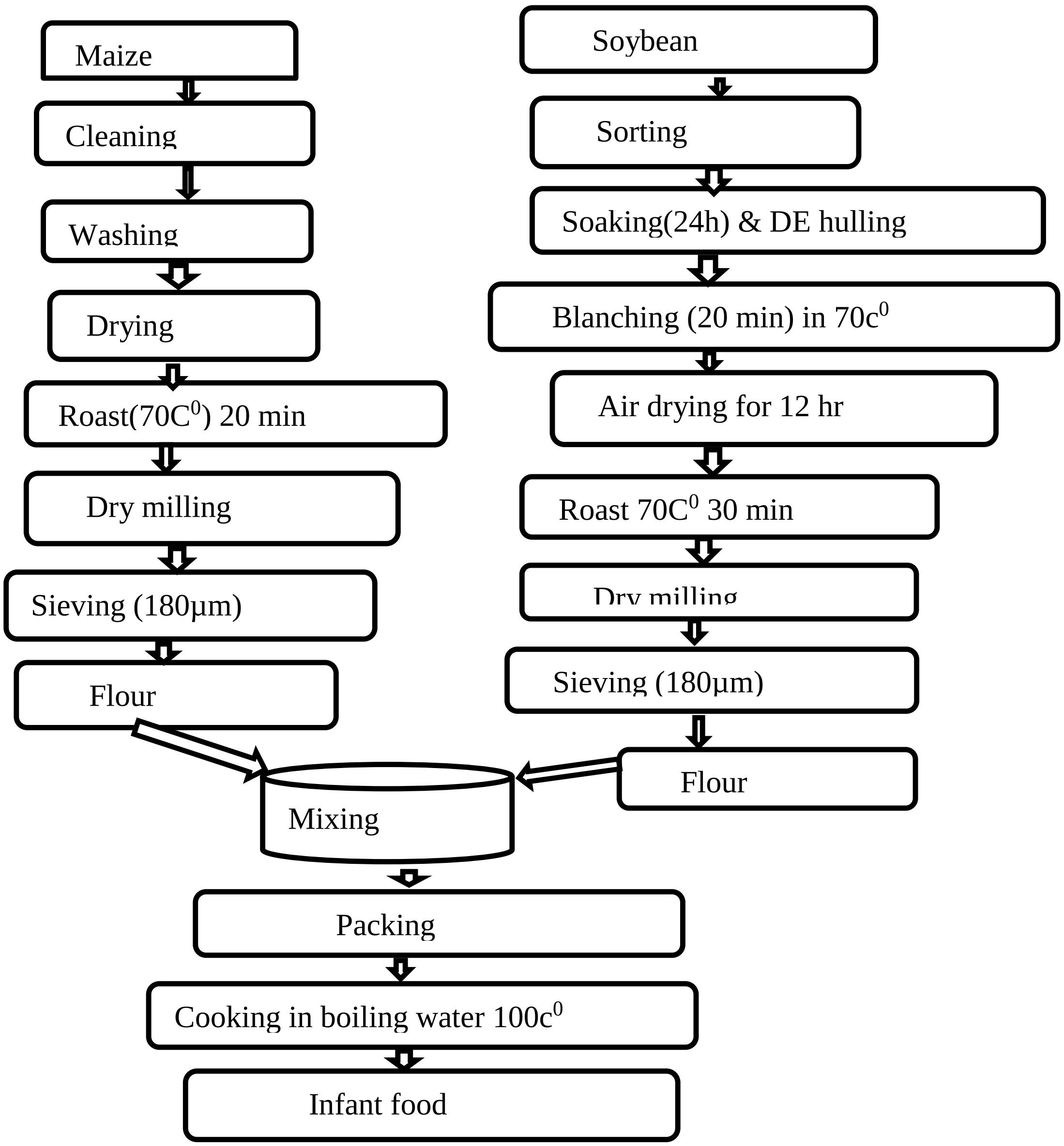

Fig 3.1 Flow diagram for the preparation of supplementary infant food.

3.4.2. Blend formulation

Using mixture de-optimal design. The high value and low values of maize and soybean used for this experiment were (0.7,0.6) and (0.4,0.3), respectively. This high and low values were taken from the previous work of Ezeokeke and Onuoha (2016).

Table 3.1 Blending ratio of Maize and Soybean obtained from mixture de-optimal design.

Std	Ru	Block	Component 1 Maize :A	Component 2 Soybean: B
Control	1		1.00	0.00
5	2	Block 1	0.63	0.37
6	3	Block 1	0.60	0.40
8	4	Block 1	0.65	0.35
2	5	Block 1	0.65	0.35
7	6	Block 1	0.70	0.30

3.4.3. Analysis method

3.4.3.1. Proximate composition of the product flour.

The proximate composition of the product and the flours were determined according to (AOAC, 2000).

Determination of moisture content

About 5 gram of infant food was accurately weighed into a dried lid or Petri dish. The lid containing the product was heated uncovered in the oven maintained at 105 ^{o}C . The material shall be heated uncovered in the oven maintained at 105c^{0} for about 3hrs. It was cooled in the desiccators and weighed with the lid on the process of drying, cooling and weighing was repeated at 30 minute intervals until the difference between the two consecutive weighting was constant the lowest weight was recorded.

Calculation.

$$\text{Moisture (\%)(w.b.)} = \frac{W1-W2}{W1-W} * 100$$

Where,

W = weight in gram of the empty moisture dish.

W1 = weight in gram of the moisture dish with the material before drying.

W2 = weight in gram of the moisture dish with the material after drying.

Determination of fat content.

About 1 gm of sample was weighed and Placed into extraction thimble. The Sample in the thimble was covered with fat free cotton wool then Extract with ether in the sox let for 3hrs. The weighed flask was filled to 2/3 with solvent (hexane or petroleum ether) and extraction apparatus is assembled and placed on the hot plate. The hot plate and the cooling water are turned on the extraction carried on for 3hrs. The heating must be so regulated that the flow is about 150 drops of solvent per minute after 3 hours. Then condenser is removed and the thimbles contents are removed from the middle part of the apparatus by means of evaporates and dry fat in oven at 100 ^{0}c then cool in desiccators and weigh it reports per cent fat.

CALUCULATION

$$F = \frac{W2-W1}{W}*100$$

Where,

F= Crude fat content in percent weight by weight.

W1 = Weight of the extraction flask in gram (g).

W2 = Weight of the extraction flask and the dried crude fat in gram (g) .

W = Weight of sample in gram (g).

3.4.3.2. Functional properties for product.

Water absorption capacity

This was determined using the method of (Sosulski, 1982). Samples (1 g) were mixed with 10 ml of water and stirred six times for 30 min at 10 min intervals. The mixtures were centrifuged at

2000 rpm for 10 min, and supernatants were removed. Pellets were dried at 50 °C for 10 min and weighed. Water adsorption capacity was expressed as the number of grams of water retained by 100 g of material.

$$\text{Water absorption (\%)} = \frac{\text{wet sample}}{\text{dry sample}} * 100$$

Bulk density

This was determined using the method of (Sosulski, 1982). Samples (25g) was taken in to measuring cylinder and then packed. After that measured the volume and calculated the final result in g/ml.

3.4.4. Sensory Evaluation of product

The sensory quality attributes of infant food were determined according to the procedures of McWatters *et al.*, (2003). twelve panellists were selected from students of the School of food process Engineering. The panellists were asked to evaluate colour, appearance, taste, aroma, texture, mouth feel and overall acceptability of the samples on a 7-point hedonic scale (due to its success in terms of the reliability and validity of the results), ranging from 9 as like extremely to 1 as dislike extremely. In the hedonic scale, 9 represented the highest score (like extremely), 8 (like very much), 7 (like moderately, 6 (like slightly), 5 (neither like nor dislike), 4 (dislike slightly), 3 (dislike moderately), 2 (dislike very much) and 1 (dislike extremely). six samples were prepared and presented to the panellists.

3.4.5. Microbial analysis of samples

Preparation of culture media

Using pure plate method, the culture media was prepared by suspending 23g nutrient agar into one litter of distilled water. It was boiled to dissolve completely and sterilized by autoclaving (Midas 36 Prior clave, U.K) at 117ºC for 15 min. It was allowed to cool to a temperature blew 45ºC.

Total microbial load count

The pour plate method was used to determine the total count. One gram of each of the two supplementary food was suspended into 9ml of sterile distilled water in a Mac Carney bottles to give 10^{-0} dilutions. Serial dilutions were made up to 10^{-4}. Each diluents of the samples were plated out in duplicate using the pour plating technique by transferring 1ml from each Mac Carney bottle into 2 different Petri dish and pouring 15ml of the nutrient agar media on each sample as described by Badau et al. (2001). Incubation of plates were done in an aerobic for 48 h at 37°C. After incubation period the colonies appearing on the agar plates were counted using a colony counter. The average colony obtained from the countable duplicate plates, were expressed as colony forming unit per gram (Cfu/g).

3.5. Experimental Design and data analysis

Single factor mixture experimental designs were used to investigate the blending ratio of maize and soybean on the keeping quality and acceptability of infant food. To obtain the mean data each sample was duplicated. Data was analysed by one-way ANOVA and Duncan's were used to determine the difference among sample means with $P<0.05$.

CHAPTER FOUR

4. Results and Discussions

4.1. Proximate Composition of product

The supplementary food was developed from different blends of flour of maize and soy bean. The product was analysed for their proximate composition. The results are presented in table 4.1

Table 4.1. Proximate Composition of Flour Sample

SC	Moisture content	Fat content
A0	10.52 ± 5.31^{a}	4.5 ± 0.42^{b}
A1	7.10 ± 1.01^{a}	9.4 ± 0.7^{a}
A2	7.23 ± 2.39^{a}	10.60 ± 0.84^{a}
A3	6.23 ± 1.08^{a}	8.85 ± 0.77^{a}
A4	6.27 ± 3.23^{a}	10.95 ± 0.07^{a}
A5	6.48 ± 3.6^{a}	8.8 ± 0.14^{a}
Total	7.30 ± 2.71^{a}	10.85 ± 2.24^{a}

Values with the same letter in the same column were no significantly different A0: supplementary food (control) sample 100% maize, A1: supplementary food (63% maize, 37%soybeans), A2: supplementary food (60% maize, 40%soybean), A3: supplementary food (65% maize, 35% soybean**)**, A4: supplementary food (65% maize, 35% soybean) A5: supplementary food (70% maize, 30% soybean**).**

The moisture content was used as quality factor for prepared cereals which should have 3-8% of moisture content nelson (1992). The moisture content of the samples ranges from A0(10.52±5.31) to A5(6.48±3.8) was best. The moisture content of the samples ranges from A0 to A5 (6.48±3.8) was not significant difference ($P<0.05$) among the samples. Low moisture content of the supplementary blends may increase the food shelf stable. The moisture content of all the samples were lower than A0 was maize. Because the sample of A0 (10.52±5.31) was higher moisture due to soya bean and maize not blended.

Fat blende varies from A0(4.5±0.42) and other the fat content of maize lower than soybean because A0 was control or not blended soybean The fat content of the samples ranges from

A0(4.5±0.42) to A5(8.8±0.14) was significant difference (P<0.05) among the samples. Fat was important in the diets of infants and children because it provides essential fatty acids, facilitates absorption of fat soluble vitamins, and enhances dietary energy density and sensory qualities. fat may help to prevent undesirable weight grain in infant and it also reduces rancidity when exposed to hot or warm air. hence a food sample with high fat content was more liable to spoilage then with a lower fat content (oduro et al,2007). According to these information our result high fat content in A4(10.95±0.07) beset then other.

4.2. Functional properties for product

Functional property of infant food was a very important factor for determination of its acceptability by infants. As a result, this property of the formulated product was analysed at laboratory and the results are presented in Table 4.2

Table 4.2. Functional properties for product.

Sample code(SC)	Water absorption	Bulk density
A0	292.5 ± 2.404^{abc}	41.00 ± 1.41^{d}
A1	316.35 ± 2.616^{a}	48.00 ± 1.414^{c}
A2	311.05 ± 2.61^{ab}	45.00 ± 0^{bc}
A3	267.3 ± 18.38^{c}	48.5 ± 0.7^{abc}
A4	284.8 ± 2.262^{bc}	49.00 ± 1.41^{ab}
A5	303.35 ± 1.48^{ab}	52.00 ± 0.0^{a}
Total	295.89±18.28	47.25±3.69

Values with the same letter in the same column were not significantly different A0: supplementary food (control) sample 100% maize, A1: supplementary food (63% maize, 37%soybeans), A2: supplementary food (60% maize, 40%soybean), A3: supplementary food (65% maize, 35% soybean**)**, A4: supplementary food (65% maize, 35% soybean) A5: supplementary food (70% maize, 30% soybean**)**

To investigate that whether there exists a significant difference in these functional properties among the product formulations a one-way ANOVA was conducted. there was a significant difference(p<0.05) in bulk density and water absorption capacity. the sample A5 (303.35±1.48) was high amount of water absorption capacity then other in order to these result was different blended ratio. When blending soy bean decrease water absorption capacity increase.

4.3. Sensory evaluation of product.

Table 4.3**.** Sensory evaluation of product.

SC	Colour	Teste	Appearance	Aroma	Mouth feel	Texture	Overall acceptability
A0	7±1.34	7.25±1.35	6.33±1.23	7±1.75	6.5±1.67	7±1.53	6.33±1.37
A1	8.16±0.71	7.25±0.62	7±1.27	7.16±0.9	6.75±1.21	6.66±0.88	7.58±0.66
A2	7.5±1.56	7.75±1.05	7±0.95	7±1.34	6.66±1.23	6.75±1.35	7.33±1.23
A3	7.58±1.16	7.25±1.05	6.91±0.90	7.41±1.08	6.66±0.98	6.83±1.11	7±1.20
A4	7.16±1.52	6.75±1.64	6.41±1.24	6.33±1.43	6.16±1.85	6.16±1.33	8.83±1.80
A5	7.83±1.02	6.75±1.28	6.91±0.99	6.83±1.19	6.58±0.90	6.91±1.7	6.91±1.33
Total	7.54±1.27	7.16±1.17	6.76±1.10	6.95±1.31	6.55±1.32	6.72±1.26	7±1.32

Values with the same letter in the same column were not significantly different. all sample were the in this sampleA0: supplementary food (control) sample 100% maize, A1: supplementary food (63% maize, 37%soybeans), A2: supplementary food (60% maize, 40%soybean), A3: supplementary food (65% maize, 35% soybean**)**, A4: supplementary food (65% maize, 35% soybean)A5:supplementaryfoo(70%maize,30%soybean**)**

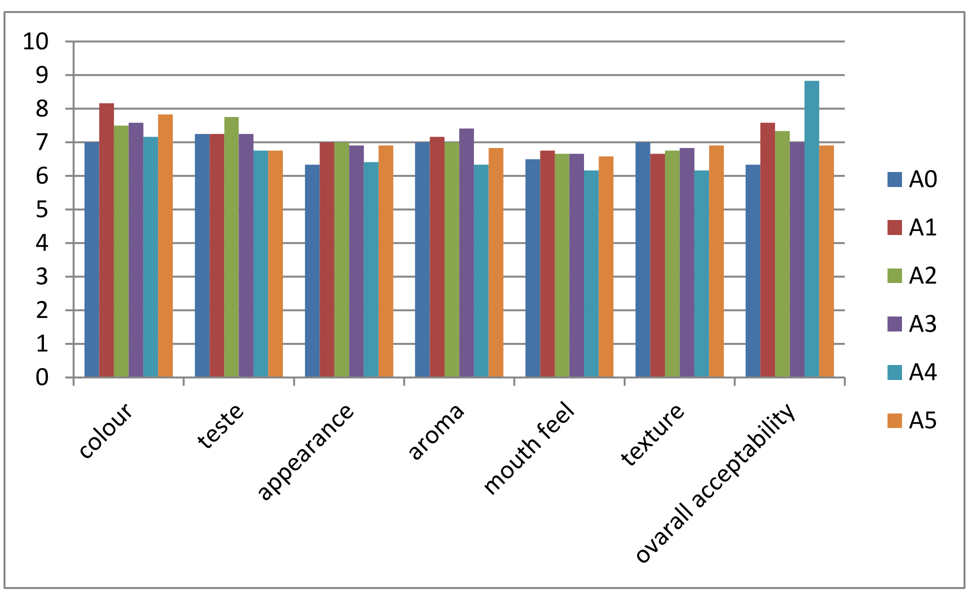

Fig 4.1 sensory evolution flow chart

The sensory evaluation was overall acceptability A4 (8.83±1.80) show in the chart indicated high value.

The sensory scored with infant food made from maize with soybeans blend, in the production of supplementary food are shown in Table 4.3. The mean sensory scores of the infant food were different in taste, flavour, mouth feel, texture, aroma colour and overall acceptability. The mean scores increase with increase in the proportion of soybean and product samples in all the infant food samples in terms of all the sensory attributes tested. The product of colour from sample A1 (8.16±0.71) test from A2(7.75±1.05) appearance from A1 (7±1.27) aroma from A3(7.41±1.08) mouth feel from A3(6.66±0.98) texture from A0 (7±1.53) and over all acceptability from A4 (8.83±1.80). Much appreciated by student. Sample were like slightly. Like very much and moderately liked.in general texture was not accepted by student because sieve size not conferrable for sieving.

4.4. Microbial analysis

Table 4.4. Microbial analysis

Sample code	Microbial analysis (cfu/ml)	According to FAO OR WHO(1995)
A0B0	236.50±5.61	Less than 106(cfu/ml)
A0B4	71±4.26	
A0B2	198.5±6.36	
A1B0	254.5±34.64	
A1B2	239.5±13.43	
A1B4	86±1.41	
A2B0	232±82.02	
A2B2	240.5±10.60	
A2B4	97±5.65	
A3B0	190.5±16.26	
A3B2	69.5±30.40	
A3B4	59.5±6.36	

A4B0	294±5.65	
A4B2	182±126.05	
A4B4	42±0	
A5B0	206±1.41	
A5B2	212.5±24.74	
A5B4	53±11.31	
Total	168.58±87.45	

Values with the same letter in the same column were not significantly different A0: supplementary food (control) sample 100% maize, A1: supplementary food (63% maize, 37%soybeans), A2: supplementary food (60% maize, 40%soybean), A3: supplementary food (65% maize, 35% soybean**)**, A4: supplementary food (65% maize, 35% soybean) A5: supplementary food (70% maize, 30% soybean**)** B0 ,B2 and B4 indicate that 10^0, 10^{-2} and 10^{-4} respectively.

Microbial analysis was conducted on freshly prepared sample to determine if blend was wholesome for consumption. Microbial count were low (42±0) in A4B4and 294±5.65in A4B0 however high count obtained. food product for consumption should have microbial count below $1*10^5$ cfu/ml WHO (1995). microbial low microbial were obtained as result of high standard personal quality of good practice observed during the food formulation process.in our result concentration increases microbial increase from (10^0 to 10^{-4}) in generally our product was best.

CHAPTER FIVE

5. Conclusions and Recommendations

5.1. Conclusions

This study has that supplementary food of acceptable quality can be produced from composite flours of maize and soybeans. The study concern that ready-to-eat supplementary food products formulated from locally available food can meet the recommended dietary allowance of the nutritional needs of infants and children from less than 2 years old. The samples produced have increased nutrients content which are all desirable for good health and wellbeing. The sample of A4 (6.27 ± 3.23) supplementary food was recorded best results in terms of proximate composition and compared favourably with the control sample A0 (10.52 ± 5.31) of moisture content. The fat content also met all the product (4.5-10.97g) and sensory evaluation provides acceptability therefore, nutritious and acceptable supplementary food can be produced. The overall acceptability from A4 (8.83 ± 1.80) accepted by student .Its low moisture content and low water activity assures of longer keeping time solving the problem of shelf instability of many soybean and maize products. A4 samples produced best for decreasing of moister content, water absorption and increasing fat content flours. Microbial count were low (42 ± 0) in A4B4and 294 ± 5.65in A4B0 however high count obtained.A0 was lowest overall acceptability highest moister content, low fat content, low balk density.

5.2. Recommendations

Development and evaluate supplementary food for infants from blends of maize flour with soybean flour. we recommend that this product quality increase blended maize flour with soybean flour to added different spices, vitamin and mineral then this product more quality. Mostly developing countries, infant the underlying problems have been identified to include poverty, inadequate nutrient intake. we recommend adequate nutrient take for infant. the decreasing of infant food production among childhood population brought malnutrition problem, from less than 2 years we recommend that increasing of infant food production. mothers should be encouraged to supplement the diet of their children with soybean flour as the main protein source in infant food preparation for most part of the infant period. Development and evaluate supplementary food for infants from blends of maize flour with soybean flour to understand more information to analysis carbohydrate ,viscosity ,protein ,ash, oil capacity and desparsablity, must be done.

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Appendix

Table 1. Descriptive analysis of the mean value of proximate

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
moisture content	A0	2	10.5200	5.31744	3.76000	-37.2553	58.2953	6.76	14.28
	A1	2	7.1000	1.01823	.72000	-2.0485	16.2485	6.38	7.82
	A2	2	7.2300	2.39002	1.69000	-14.2435	28.7035	5.54	8.92
	A3	2	6.2300	1.08894	.77000	-3.5538	16.0138	5.46	7.00
	A4	2	6.2700	3.23855	2.29000	-22.8272	35.3672	3.98	8.56
	A5	2	6.4800	3.36583	2.38000	-23.7608	36.7208	4.10	8.86
	Total	12	7.3050	2.77341	.80061	5.5429	9.0671	3.98	14.28
fat content	A0	2	4.5000	.42426	.30000	.6881	8.3119	4.20	4.80
	A1	2	9.4000	.70711	.50000	3.0469	15.7531	8.90	9.90
	A2	2	10.6000	.84853	.60000	2.9763	18.2237	10.00	11.20
	A3	2	8.8500	.77782	.55000	1.8616	15.8384	8.30	9.40
	A4	2	10.9500	.07071	.05000	10.3147	11.5853	10.90	11.00
	A5	2	8.8000	.14142	.10000	7.5294	10.0706	8.70	8.90
	Total	12	8.8500	2.24479	.64802	7.4237	10.2763	4.20	11.20

ANOVA

		Sum of Squares	Df	Mean Square	F	Sig.
moisture content	Between Groups	26.583	5	5.317	.550	.736
	Within Groups	58.027	6	9.671		
	Total	84.610	11			
fat content	Between Groups	53.400	5	10.680	31.567	.000
	Within Groups	2.030	6	.338		
	Total	55.430	11			

Calculation.

Moisture (%)(w.b.) = $\frac{W1-W2}{W1-W} * 100$

Where,

W = weight in gram of the empty moisture dish.

W1 = weight in gram of the moisture dish with the material before drying.

W2 = weight in gram of the moisture dish with the material after drying.

CALUCULATION

$$F = \frac{W2-W1}{W}*100$$

Where,

F= Crude fat content in percent weight by weight.

W1 = Weight of the extraction flask in gram (g).

W2 = Weight of the extraction flask and the dried crude fat in gram (g) .

W = Weight of sample in gram (g).

Appendix

Table 2. Descriptive analysis of the mean value of functional properties

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
water absorption	A0	2	292.5000	2.40416	1.70000	270.8995	314.1005	290.80	294.20
	A1	2	316.3500	2.61630	1.85000	292.8435	339.8565	314.50	318.20
	A2	2	311.0500	2.61630	1.85000	287.5435	334.5565	309.20	312.90
	A3	2	267.3000	18.38478	13.00000	102.1193	432.4807	254.30	280.30
	A4	2	284.8000	2.26274	1.60000	264.4701	305.1299	283.20	286.40
	A5	2	303.3500	1.48492	1.05000	290.0085	316.6915	302.30	304.40
	Total	12	295.8917	18.28240	5.27768	284.2756	307.5078	254.30	318.20
bulk density	A0	2	41.0000	1.41421	1.00000	28.2938	53.7062	40.00	42.00
	A1	2	48.0000	1.41421	1.00000	35.2938	60.7062	47.00	49.00
	A2	2	45.0000	.00000	.00000	45.0000	45.0000	45.00	45.00
	A3	2	48.5000	.70711	.50000	42.1469	54.8531	48.00	49.00
	A4	2	49.0000	1.41421	1.00000	36.2938	61.7062	48.00	50.00
	A5	2	52.0000	.00000	.00000	52.0000	52.0000	52.00	52.00
	Total	12	47.2500	3.69582	1.06689	44.9018	49.5982	40.00	52.00

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
water absorption	Between Groups	3311.914	5	662.383	10.895	.006
	Within Groups	364.795	6	60.799		
	Total	3676.709	11			
bulk density	Between Groups	143.750	5	28.750	26.538	.001
	Within Groups	6.500	6	1.083		
	Total	150.250	11			

$$\text{Water absorption (\%)} = \frac{\text{wet sample}}{\text{dry sample}} * 100$$

Appendix

Table 3. Descriptive analysis of the mean value of sensory analysis

Descriptive

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Colour	A0	12	7.0000	1.34840	.38925	6.1433	7.8567	4.00	9.00
	A1	12	8.1667	.71774	.20719	7.7106	8.6227	7.00	9.00
	A2	12	7.5000	1.56670	.45227	6.5046	8.4954	3.00	9.00
	A3	12	7.5833	1.16450	.33616	6.8434	8.3232	6.00	9.00
	A4	12	7.1667	1.52753	.44096	6.1961	8.1372	4.00	9.00
	A5	12	7.8333	1.02986	.29729	7.1790	8.4877	6.00	9.00
	Total	72	7.5417	1.27751	.15056	7.2415	7.8419	3.00	9.00
Taste	A0	12	7.2500	1.35680	.39167	6.3879	8.1121	5.00	9.00
	A1	12	7.2500	.62158	.17944	6.8551	7.6449	7.00	9.00
	A2	12	7.7500	1.05529	.30464	7.0795	8.4205	6.00	9.00
	A3	12	7.2500	1.05529	.30464	6.5795	7.9205	5.00	9.00
	A4	12	6.7500	1.42223	.41056	5.8464	7.6536	4.00	9.00
	A5	12	6.7500	1.28806	.37183	5.9316	7.5684	5.00	9.00
	Total	72	7.1667	1.17485	.13846	6.8906	7.4427	4.00	9.00
Appearance	A0	12	6.3333	1.23091	.35533	5.5512	7.1154	4.00	8.00
	A1	12	7.0000	1.27920	.36927	6.1872	7.8128	4.00	9.00
	A2	12	7.0000	.95346	.27524	6.3942	7.6058	5.00	8.00
	A3	12	6.9167	.90034	.25990	6.3446	7.4887	5.00	8.00
	A4	12	6.4167	1.24011	.35799	5.6287	7.2046	4.00	8.00
	A5	12	6.9167	.99620	.28758	6.2837	7.5496	5.00	9.00
	Total	72	6.7639	1.10687	.13045	6.5038	7.0240	4.00	9.00

Aroma	A0	12	7.0000	1.75810	.50752	5.8830	8.1170	3.00	9.00
	A1	12	7.1667	.93744	.27061	6.5710	7.7623	6.00	9.00
	A2	12	7.0000	1.34840	.38925	6.1433	7.8567	5.00	9.00
	A3	12	7.4167	1.08362	.31282	6.7282	8.1052	5.00	9.00
	A4	12	6.3333	1.43548	.41439	5.4213	7.2454	4.00	9.00
	A5	12	6.8333	1.19342	.34451	6.0751	7.5916	5.00	9.00
	Total	72	6.9583	1.31554	.15504	6.6492	7.2675	3.00	9.00
mouth feel	A0	12	6.5000	1.67874	.48461	5.4334	7.5666	2.00	8.00
	A1	12	6.7500	1.21543	.35086	5.9778	7.5222	4.00	8.00
	A2	12	6.6667	1.23091	.35533	5.8846	7.4488	5.00	9.00
	A3	12	6.6667	.98473	.28427	6.0410	7.2923	5.00	8.00
	A4	12	6.1667	1.85047	.53418	4.9909	7.3424	2.00	9.00
	A5	12	6.5833	.90034	.25990	6.0113	7.1554	5.00	8.00
	Total	72	6.5556	1.32036	.15561	6.2453	6.8658	2.00	9.00
Texture	A0	12	7.0000	1.53741	.44381	6.0232	7.9768	5.00	9.00
	A1	12	6.6667	.88763	.25624	6.1027	7.2306	5.00	8.00
	A2	12	6.7500	1.35680	.39167	5.8879	7.6121	4.00	9.00
	A3	12	6.8333	1.11464	.32177	6.1251	7.5415	5.00	8.00
	A4	12	6.1667	1.33712	.38599	5.3171	7.0162	4.00	8.00
	A5	12	6.9167	1.37895	.39807	6.0405	7.7928	5.00	9.00
	Total	72	6.7222	1.26960	.14962	6.4239	7.0206	4.00	9.00
overall acceptability	A0	12	6.3333	1.37069	.39568	5.4624	7.2042	4.00	8.00
	A1	12	7.5833	.66856	.19300	7.1586	8.0081	7.00	9.00
	A2	12	7.3333	1.23091	.35533	6.5512	8.1154	5.00	9.00
	A3	12	7.0000	1.20605	.34816	6.2337	7.7663	5.00	9.00
	A4	12	6.8333	1.80067	.51981	5.6892	7.9774	3.00	9.00
	A5	12	6.9167	1.31137	.37856	6.0835	7.7499	5.00	9.00
	Total	72	7.0000	1.32154	.15575	6.6895	7.3105	3.00	9.00

ANOVA

		Sum of Squares	Df	Mean Square	F	Sig.
colour	Between Groups	4.000	1	4.000	8.000	.106
	Within Groups	1.000	2	.500		
	Total	5.000	3			
aroma	Between Groups	.250	1	.250	.027	.885
	Within Groups	18.500	2	9.250		
	Total	18.750	3			

APPENDIX

Table 4. Descriptive analysis of the mean value of microbial analysis

Descriptives

MICROBIAL COUNT

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
A0B0	2	236.5000	51.61880	36.50000	-227.2765	700.2765	200.00	273.00
AOB2	2	198.5000	6.36396	4.50000	141.3221	255.6779	194.00	203.00
A0B4	2	71.0000	4.24264	3.00000	32.8814	109.1186	68.00	74.00
A1B0	2	254.5000	34.64823	24.50000	-56.8020	565.8020	230.00	279.00
A1B2	2	239.5000	13.43503	9.50000	118.7911	360.2089	230.00	249.00
A1B4	2	86.0000	1.41421	1.00000	73.2938	98.7062	85.00	87.00
A2B0	2	232.0000	82.02439	58.00000	-504.9599	968.9599	174.00	290.00
A2B2	2	240.5000	10.60660	7.50000	145.2035	335.7965	233.00	248.00
A2B4	2	97.0000	5.65685	4.00000	46.1752	147.8248	93.00	101.00
A3B0	2	190.5000	16.26346	11.50000	44.3786	336.6214	179.00	202.00
A3B2	2	69.5000	30.40559	21.50000	-203.6834	342.6834	48.00	91.00
A3B4	2	59.5000	6.36396	4.50000	2.3221	116.6779	55.00	64.00
A4B0	2	294.0000	5.65685	4.00000	243.1752	344.8248	290.00	298.00
A4B2	3	182.0000	126.05158	72.77591	-131.1295	495.1295	39.00	277.00
A4B4	1	42.0000	.	.	.	.	42.00	42.00
A5B0	2	206.0000	1.41421	1.00000	193.2938	218.7062	205.00	207.00
A5B2	2	212.5000	24.74874	17.50000	-9.8586	434.8586	195.00	230.00
A5B4	2	53.0000	11.31371	8.00000	-48.6496	154.6496	45.00	61.00
Total	36	168.5833	87.45787	14.57631	138.9918	198.1748	39.00	298.00

ANOVA

MICROBIAL COUNT

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	222950.250	17	13114.721	5.274	.001
Within Groups	44760.500	18	2486.694		
Total	267710.750	35			

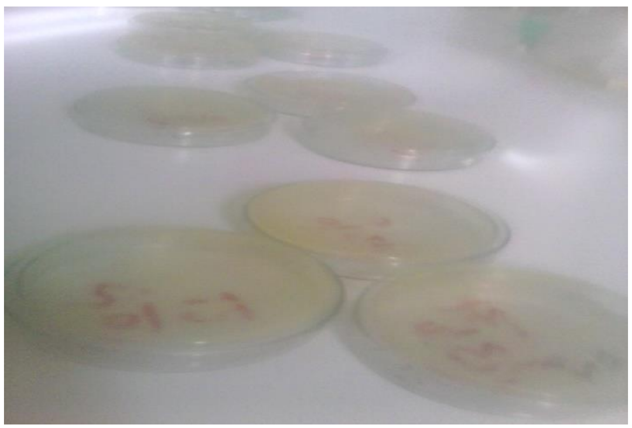

Fig 2: microbial count

Fig 1: proximate comopstion of fat

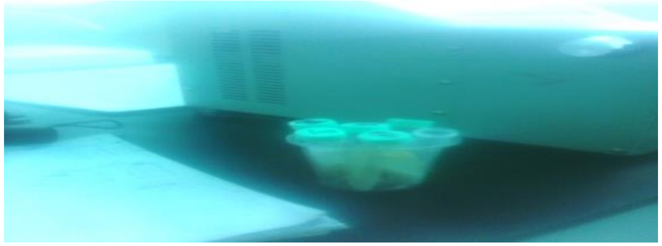

Fig 3 :functional property

Fig 4: sensory evaluation