# EFFECT OF LOCALLY SOURCED PREBIOTICS INGREDIENTS ON THE PROXIMATE COMPOSITION AND SENSORY ATTRIBUTES OF ICE CREAM

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## ABSTRACT
Prebiotics are non-digestible food ingredients that beneficially affect the host by selectively stimulating growth or activity of beneficial bacteria in the colon. The research objective was to determine the effect of locally sourced prebiotics ingredients on nutrient and consumer acceptability of ice cream with prebiotic ingredients. Three different commercial ice cream mix were made substituting 20% of ice cream for Garlic, Ginger and Onion, coded as (C1, C2, and C3) with a fourth sample of whole ice cream produced as a control coded as C4. A fifth ice cream was bought from a grocery store as a super control coded as C5. The samples were analyzed and the result of the proximate composition indicated the fat, crude fibre, moisture and carbohydrate contents of the yoghurt samples differs significantly ($P < 0.05$). However there is no significant difference ($P > 0.05$) in protein content of C1 and the ash content of C2 and C4. Sensory analyses were conducted using 30 non-trained panelists. Overall consumer acceptability and sensory attributes were measured on a 175 mm anchored hedonic scale. When ice cream mix with 20% prebiotics ingredients of (Garlic, Ginger and onion) were compared to the control (0%), there was a significant difference ($P < 0.05$) between C2 and C3 ice cream in aroma and taste. C1 C2, C4 and C5 has no significant difference in sweetness, smoothness or overall acceptability at ($P > 0.05$). These results suggest that Ginger, Garlic and Onion can be an acceptable ingredients in ice cream when substituted for up to 20%. Hence, it was recommended that further studies be carried out to determine the effect of prebiotics on the melting and freezing point in ice cream.

**Key words:** Ice Cream; Ginger; Onion; Garlic; Nutrients, Sensory Attributes.

## INTRODUCTION
Prebiotics are non-digestible food ingredients that positively affect the body by stimulating the growth and activity of bacteria in the colon. They are substances that modify the colonic microflora, stimulating the proliferation and growth of non-pathogenic bacteria with health promoting potential (Kaur and Gupta, 2002 ). Some examples of prebiotics include fructooligosaccharides, arabinose, galactose, inulin, raffinose, mannose, lactose, stachyose, mannanoligosaccharides, xylooligosaccarides, palatinose, lactosucrose, glycooligosaccharides, isomaltooligosaccharides, soybean oligosaccharide, e.t.c (Saier and Mansour,2005).

**Prebiotics plays important roles in human nutrition such as:**
Maintenance of intestinal flora and stimulation of intestinal transit. Prebiotics contributes to Changes in colonic microflora, contributing to normal stool consistency, preventing diarrhea and constipation (Bosscher et al., 2006): Elimination of excess substance such as glucose and cholesterol, favoring only the absorption of substances needed (Kaur and Gupta, 2002): Stimulation of the growth of bifidobacteria: stimulation of the absorption and production of B vitamins (B1, B2 B3 B6, B9, B12) (Wang and Gibson, 1993): Support of the immune system (Silva and Nornberg, 2003): Contribution to the control of obesity (Manning and Gibson, 2004): Contribution to the decrease of the risk of osteoporosis (Kaur and Gupta, 2002).
Prebiotics are found in vegetables, such as leeks, onions, chicory, tomatoes, asparagus,

artichokes, garlic, ginger, bananas, and alfalfa. It is added to industrial products such as foods for children, diary, confectionery products, beverages, light mayonnaise and low-fat cheese, and are used as dietary supplements (Saier and Mansour, 2005).

Prebiotics are being used in the food industry as functional ingredients in beverages (fruit juices, coffee, cocoa, tea, soft drinks and alcoholic beverages), milk products (fermented milk, milk powder and ice cream), probiotics yoghurts and symbiotic products ( Gibson and Roberfroid, 1995). Other applications include desserts (e.g., jellies, pudding, fruit-flavored ice cream). Confectionery items (e.g., fish paste and tofu. Prebiotics can also be used in comestics, pharmaceuticals products and for people with diabetes ( Mussatto and Mancilha, 2007).

Ice cream are frozen food eaten as dessert, and is made from dairy products such as milk or cream combined with fruits and desirable flavors. Ice cream is composed of mixture of air, milk fat, milk solid non-fat (MSNF), sweeteners, stabilizers emulsifiers and flavors (Marshal et al., 2003). Ice cream is an excellent source of energy, it is rich in carbohydrate, with about 15grams in a one-half –cup serving. A serving also contains about 7grams of fat and 2grams of protein, making it an energy-dense food. It is also a good dietary source of several important minerals, particularly rich in calcium and phosphorus, with about 10 percent of adult recommended Dietary Allowance (RDA) of these minerals in a one-half-cup serving. Ice cream also contains many vitamins, including vitamin A, C, D and E as well as thiamin, riboflavin, niacin, and folate (USDA, 2005).
The high palatability and digestibility of ice cream is an important factor in its choice as a food of great appeal among significant number of people worldwide (Institute of Medicine, 2011).
The conventional process for ice cream production involves; blending of the mix ingredients, pasteurization, homogenization, aging the mix, freezing, packaging and hardening (Marshall et al., 2003).

Ice cream is a popular product consumed by people of all ages. Due to its popularity and its beneficial composition. It is used for the delivery of prebiotics (Marshal et al., 2003). EL-Nager and others (2002) reported that prebiotics reduce the melting rate, affects its proximate composition and increase the firmness in ice cream. (Akin et al., 2007) also buttress the point that the addition of prebiotics retarded the melting time and texture of probiotic-fermented ice cream.

Hence, this work would seek to evaluate the proximate composition and sensory attributes of ice cream when locally sourced prebiotic ingredients are added.
Garlic (Allium sativum) Ginger (Zingiber officinale) and Onion (Allium cepa) are three food ingredients widely used in our gastro intestinal tract (GIT). Their extracts have been reported to be effective in the treatment of cardiovascular disease, because of their hypocholesterolemic, hypolipidemic, anti-hypertensive and anti-diabetic effects and possess many other biological activities which includes antimicrobial, antioxidant, anticarcinogenic, antimutagenic, antiasthmatic and prebiotic activities. Given the importance of these vegetables and derived supplements in feeding and therapeutic effect. The need to study their role as prebiotic food vehicles has become very imperative. The present work focus on the influence of prebiotics and its adverse effects and interactions on the nutrients, functional and sensory properties of ice cream.

Garlic (Allium sativa) is known as Tarfanuwa in hausa. Galiki in igbo and Aayu in Yoruba (Chidiogu et al, 2003). The spice crop is predominantly cultivated in Nigeria along the fadama areas of Sokoto, Kano and Borno state ( NAERLS, 2002). The crop has been reported to have several food and medicinal uses. It is used for preserving meat and meat products, used as spices in salad and for seasoning of vegetables. Garlic extracts are generally used in curing whooping cough, lung diseases, stomach pain and child birth disorder. The extract is also used for ear-ache,

hypertension, eye-sores, an antidiote against poisons, and as an antibiotic (Debkitaniya et al., 1981). Garlic could also be used as an insecticide and could reduce cholesterol level in human blood as well as repulsicant to snakes. Nutritionally, a one ounce (28grams) serving of Garlic contains 42 calories of energy. 1.8grams of protein, 9 grams of carbohydrate, 23% of the RDA for manganese, 17% of the RDA for vitamin B6, 15% of the RDA for vitamin c, 6% of the RDA for selenium, 1 gram of fibre and good amounts of calcium, copper, potassium, phosphorus, iron and vitamin B1. Garlic also contains trace amount of other nutrients (U.S.D.A, 2005).

Ginger (Zingiber officinale) is known as citta in hausa , Ataile in Yoruba and Jinja in igbo (Chidiogu et al, 2013). The plant is cultivated majorly in the northern savanna region were extensive irrigation farming is practice (RMRDC, 2012). Ginger is one of the healthiest and most delicious spices in the world. It is rich in nutrients and bioactive compounds that have important benefits for the human body. Ginger has a very long history of use in various forms of traditional/alternative medicine. It has been used to help digestion, reduce nausea and help fight flu and common cold.

Onion (Alium cepa) is known as albasa in hausa, yabasi I igbo and alubosa in yoruba ( Chidiogu et al, 2013). Onions are predominantly cultivated in the northern region of the country along the fadama areas of Sokoto, Kano, Zamfara, Borno and yobe states. There are health benefits of consuming onions such as : lowering the risk of several types of cancer, improving mood and maintaining the health of skin and hair. Nutritionally, onions are a nutrient-dense food, meaning that while they are low in calories they are high in beneficial nutrients like vitamins, minerals and antioxidants. One cup of chopped onion contains approximately 64 calories, 15 grams of carbohydrate, 0 grams of fat, 0 grams of cholesterol, 3 grams of fiber, 7 grams of sugar, 2 grams of protein and 10% or more of the daily value for vitamin C, vitamin B-6 and manganese. Onion also contains small amounts of calcium, iron, folate, magnesium, phosphorus and potassium and the antioxidants quercetin and sulfur.

Ice cream production and sale are mostly done by small businesses owners; such as caterers and restaurant operators with few large multinational conglomerates involve in the business. The production of ice cream involve the use of an ice cream maker that churns the ice cream mixture while cooled inside a household freezer or using a solution of pre-frozen salt and water which gradually melt while the ice cream freezes (Calaresu and Melissa, 2013).

Consumption of ice cream globally is estimated to be approximately thirty (30) billion litres per annum, with an estimated market worth of 52.5 billion dollars in 2012 (Tharp et al.,2013). Nigeria presently is ranked fifteen in Africa in terms of ice cream consumption. But recent trends indicates an increase in the rate of consumption, with a 14% growth rate in 2014 (FAO, 2015).

Increase in ice cream consumption in Nigeria is underpinned by rising disposable income and the growth of western consumption habits by Nigerian consumers, improved products and packaging techniques increase in population growth, improved distribution networks and wider range of products variant all contributing to fueling growth (FAO, 2014).

Ice cream presently account for about 10% of the value share of all packaged food products in Nigeria, With its consumption highest among children, teenagers and young adults, and this population group account for over sixty percent of the total population in Nigeria. Therefore the prospect for its further growth are enormous (FAO, 2014).

Ice cream is a high fat food, since it must contain greater than 10 percent milk fat to be designated as ice cream. Milk fat is largely cholesterol, a saturated fat. When blood cholesterol level is high it can build up as a plague, a fatty deposit in the arteries that interferes with blood flow and causes

the risk of heart disease and stroke. Ice cream is also high in sugar which makes up the majority of its carbohydrate content (Agrawal, 2009). Hence, consumption of too much sugar may contribute to health problems such as weight gain, cavities and increased level of blood triglycerides, another type of unhealthy fat. Since ice cream accounts for an estimated 10% share of the packaged processed food sector and with its increased popularity and consumption among our younger population and with increasing incidence of chronic diseases such as; diabetes, cancer, obesity and high blood pressure among our populace. There is need to incorporate locally sourced health promoting prebiotic ingredients.

Application of prebiotics on ice cream has focused mainly on their use as sugar substitute and as a health promoting ingredient. Little is known about the role of prebiotics in altering the nutrient composition, sensory attributes, functional properties and microbial load of the ice cream. Furthermore no available literatures exist on the use of locally sourced prebiotic ingredients indigenous to Nigeria. Hence this research would seek to evaluate the effect on the use of locally available prebiotic ingredients on the proximate composition and sensory attributes of ice cream.

**Materials and Methods**

Collection identification and preparation of test samples containing prebiotics: Allium sativum (garlic), Zingiber officinale (ginger), and Allum cepa var. cepa (onion)

Samples were purchased from the Sabon Gari Market in Zaria. The plants were identified at the herbarium of biological science Department Ahmadu Bello University, Zaria with a voucher number deposited. Materials were procured in their unprocessed state. The purchased ginger was thoroughly washed with tap water. The light outer skin of the washed ginger rhizomes were scrapped off using a blunt knife and cut into tiny pieces. The light scaly leaves on the onion bulbs and garlic cloves were removed and the naked bulbs and cloves washed in water before being chopped into tiny pieces. All samples prepared were dried in an air-circulating oven in the laboratory and ground manually into a fine powder, using manual grinder. The powder of each sample were sieved through mesh 300µm and stored in an air-tight cellophane bag as stock sample in a refrigerator until required for analysis (A.O.A.C. (1991).

**Ice cream Production Process**

Production of ice cream was done adapting the production from Marshal (2003) for basic ice cream production using a 1000ml sample (see figure 1). Three 1000ml treatment samples were produced substituting part of the ice cream in the control recipe with prebiotic ingredients. A control batch was also made. All samples were produced weighing liquid and dry ingredient in separate containers. The liquid and dry ingredients were then mixed together and the ice cream mix were quickly poured into the freezing chamber of an ice cream maker.

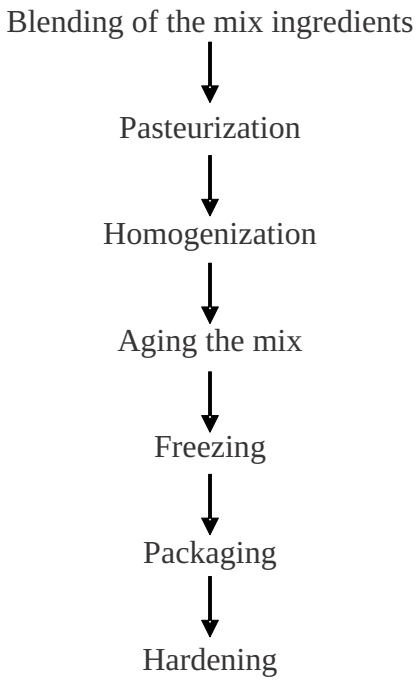


**Figure 1:** Ice Cream Production Flowchart
**Source:** Marshall et al. (2003)

**Recruitment**
Recruitment of participants where done randomly among staffs and students of the school of vocational and Technical Education, Federal College of Education Zaria.

**Sensory Testing**
Participants were asked to read and sign an informed consent form, prior to the sensory evaluation. Participants were then asked to taste five ice cream samples consisting of a super control, control and three samples of ice cream containing prebiotics ingredient replacing ice cream at 20%. Ice cream samples were presented all at one and in no specific order, with random numbers written on the containers.

Five different sensory forms were presented to each participant, stapled together, with the control number on the top sheet and then in order of garlic, ginger and onion, with only the random numbers listed. A glass of water was included on the tray. Participants were asked to taste the ice cream samples in the order of the sensory forms place on the tray. Participants were also asked to rate the ice cream for the sensory attributes of sweetness, smoothness, tartness, hardness and overall acceptability for each sample on a 175mm anchored hedonic scale. Participants were instructed to cleanse the pallet with water between tasting each sample.

**Proximate Analysis**
The nutrients analyzed include crude protein, crude lipid, ash content, moisture content, total carbohydrate, total energy, using standardized method and procedure. The kjedahl method was used to analyze for protein in the ice creams, the Werner schmidt extraction method was used to analyzed for crude fat, while the ignition method described by A.O.A.C (2005) was used to determine the ash content. The thermal drying method described by A.O.A.C (2005) was used to analyze for moisture in the sample. Carbohydrate was calculated by subtracting the amount of ash, protein, moisture, and fat from 100 (Differential method) described by A.O.A.C (1991).
Statistical Analysis

Statistical analysis was conducted using SAS (version 9.1) to determine the means and standard deviation of the sensory data. An analysis of variance was done to determine statistical significance and Least Square Means test of the proximate data was conducted to determine differences between means.

## RESULTS

**Table 1:** Proximate Composition of the Different Ice Cream Samples

| **Samples** | | | **Parameters (%)** | | | |
|---|---|---|---|---|---|---|
| | **Protein** | **Fat** | **Crude Fibre** | **Ash** | **Moisture** | **CHO** |
| C1 | $3.15\pm0.31^{b}$ | $1.64\pm0.46^{a}$ | $0.21\pm0.61^{e}$ | $1.58\pm0.44^{a}$ | $77.06\pm0.22^{e}$ | $11.69\pm0.31^{b}$ |
| C2 | $4.10\pm0.65^{c}$ | $1.82\pm0.71^{c}$ | $0.36\pm0.87^{d}$ | $0.46\pm0.27^{c}$ | $76.18\pm0.99^{c}$ | $11.38\pm0.21^{c}$ |
| C3 | $4.68\pm0.87^{d}$ | $1.73\pm0.97^{b}$ | $0.44\pm0.71^{c}$ | $0.38\pm0.78^{b}$ | $78.06\pm0.47^{d}$ | $12.85\pm0.73^{a}$ |
| C4 | $3.12\pm0.56^{a}$ | $1.38\pm0.32^{d}$ | $0.51\pm0.61^{a}$ | $0.41\pm0.58^{c}$ | $79.64\pm0.44^{b}$ | $9.38\pm0.54^{e}$ |
| C5 | $3.64\pm0.42^{b}$ | $2.01\pm0.24^{e}$ | $0.46\pm0.53^{b}$ | $0.40\pm0.11^{d}$ | $79.11\pm0.26^{a}$ | $10.28\pm032^{d}$ |
| LSD | 0.03 | 0.03 | 0.02 | 0.02 | 0.06 | 0.09 |

Values are means ± SD triplicate determinations
Values with different superscript within the same column are significantly different ($p<0.05$)
Five Ice Cream Samples= C1, C2, C3, C4and C5
LSD = Least Significant Difference
C1= Ice Cream + Ginger
C2= Ice Cream + Garlic
C3= Ice Cream + Onion
C4= Control
C5= Super Control

### Discussion

Based on the results obtained from Table 1, there is no significant difference in the protein content of C1 and C5 samples at ($P>0.05$). but there is significant difference across all samples for crude fat at ($P<0.05$). this is due to the oxidation of cholesterol by prebiotics, this supports the assertion stated by (Bosscher et al, 2006), in which it was stated that prebiotics helps eliminate excess glucose and cholesterol. Crude fibre, moisture, and carbohydrate content also differ significantly at ($P<0.05$). this is also in agreement with the statement made by (Bosscher et al,2006) and supported by (Kaur and Gupta, 2002). Generally speaking the proximate composition of ice cream using prebiotics ingredients have not been negatively impacted.

**Table 2:** Result of the Sensory Analysis of the different Ice Cream Samples Sample

| **Parameters** | **Appearance** | **Aroma** | **Texture** | **Taste** | **General Acceptability** |
|---|---|---|---|---|---|
| C1 | $7.78^{a}$ | | $8.22^{a}$ | $6.67^{a}$ | $7.56^{a}$ |
| C2 | $7.22^{ab}$ | | $7.89^{ab,}$ | $6.89^{a}$ | $7.00^{ab}$ |
| C3 | $7.22^{ab}$ | | $7.11^{b}$ | $7.56^{a}$ | $6.56^{ab}$ |
| C4 | $6.78^{b}$ | | $7.33^{ab}$ | $6.78^{a}$ | $6.00^{b}$ |
| C5 | $7.56^{ab}$ | | $8.00^{ab}$ | $7.44^{a}$ | $7.33^{a}$ |
| LSD | 0.91 | 0.95 | 1.47 | 1.15 | 1.22 |

Values are means ± SD duplicate determinations
Values with different superscript within the same column are significantly different ($p<0.05$)
Five Ice Cream samples= C1, C2, C3, C4 and C5
LSD = Least Significant Difference.

C1= Ice Cream + Ginger
C2= Ice Cream + Garlic
C3= Ice Cream + Onion
C4= Control
C5= Super Control

## DISCUSSION

The result in Table 2 indicates that there is no significant difference among all samples for texture, taste and general acceptability at ($P>0.05$). there is significant difference in sample C4 for appearance and taste compared to the super control at ($P<0.05$). these might be due to preparation drawbacks and lack of stabilizers and flavoring matters.

## CONCLUSION

In conclusion prebiotics have no effect on the proximate and sensory characteristics in ice cream.

## RECOMMENDATIONS

It is recommended that further studies should be conducted to determine the effect of prebiotics on the melting and freezing point in ice cream.
The use of prebiotics as an alternative substitute for sugar should be investigated.
Further studies should be carried out on the functional properties of ice cream mix with prebiotics ingredients.

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