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Research Article

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Production of a Confectionary Snack Food (Biscuit) from Orange Pulp in Maiduguri, Borno State Nigeria

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Abstract The protein content of the biscuit prepared with 10 % orange pulp flour was 12.84 %, a value lower than 15.19 % for wheat flour biscuit. The low protein content of the orange peel flour may have contributed to the lower protein content of its biscuit. The protein content of the biscuit containing 10 % orange pulp flour was higher than 7.44 % (Youssef and Mausa, 2012) and 10.98 % (Magda et al., 2008). These differences may be attributed to the differences in the recipes used for the production of the different biscuits. The addition of orange pulp flours increased the fibre content of the biscuits significantly ($p<0.05$). The 100 % wheat flour biscuit had fibre content of 1.33 %, a value which increased to 8.17 % and 11.22 % in biscuits containing 10 % orange pulp flours. People who already have diverticulosis often find that increased fibre consumption can alleviate symptoms, which include constipation and or diarrhea, abdominal pain, flatulence and mucus or blood in the stool (Anon, 2004). The ash contents of the biscuits ranged from 1.23 % to 2.13 %, with the 100 % wheat flour biscuit having the lowest value of 1.23 %. The higher ash content of biscuit produced with orange pulp (1.81 %) may be attributed to the higher ash content of the orange pulp flour. The 100 % wheat flour biscuit had the highest carbohydrate content of 60.73 %. This value was followed by that of the biscuit prepared with 10 % orange pulp flour. Biscuit produced with 100 % wheat flour had the highest energy value of 439.52 Kcal. The energy value of a food is related to its protein, fat and carbohydrate contents. The higher protein, fat and carbohydrate contents of the wheat biscuits may thus have contributed to its higher energy value in relation to those of the orange based biscuits. Biscuit is an energy food which is taken mostly in between meals by both young and old (Giwa and Ikejenlola, 2010).

Keywords Confectionary Snack Food, Biscuit, Orange Pulp

Introduction

Confectionaries are dried food with very low moisture content which can be kept in a dry place at a low or higher temperate area for long. Biscuit is a confectionary, dried to very low moisture content [1]. Biscuit is a snack food which can be eaten in-between meals or at any time of the day and by any age bracket. An increasing proportion of the household food budget in Nigeria is spent on snacks in which convenience and quality are perceived as most important [2]. Generally, biscuits contain fat (18.5 %), carbohydrate (78.23%), ash (1.0 %) and salt (0.85 %) [3]. They are generally characterized by a low moisture content [1]. The shelf life is several months under correct storage conditions [4]. However, biscuits must be packaged in containers which prevent moisture uptake [1].

Chemical Composition of Orange Fruit

Fruit composition is influenced by a large number of natural factors including variety of fruit, geographical location, climatic zone, soil, degree of maturity etc. The composition of juice products may be influenced by technology used in processing and packaging [5]. The edible portion is the endocarp surrounding the endocarp is the peel, which comprises 20 to 50 % of the weight of the fruit and consists of flavedo and albedo. The flavedo, or outer peel is a layer of tissue underlying the epidermis and contains the chromoplast and oil sacs. The albedo, or inner peel is a layer of spongy white tissue which is connected to the core and supplies the water and nutrients from the tree which are necessary for fruit growth and development [6].

The proximate composition of the edible portion is water, 86%, protein, 0.6%, fat, 0.1%, micronutrients per 100g: calcium, 24 mg, iron, 0.3 mg, vitamin A, 120 iu, thiamine, 0.06 mg, riboflavin, 0.02 mg, niacin, 0.1mg and ascorbic acid, 36mg. The pH of the orange is around 3.5, the main enzyme system is a methyl esterase which hydrolyses polygalacturonic acid polymethyl esters. The principal pigments which develop on ripening are carotenoids, mainly xanthophylls 5, 6 and 5, 8 – epoxides. The major volatile components of whole oranges are d-limonene, beta-mycrene, alpha pinene, acctaldehyde, octanal, ethanol and ethyl acetate [6].

Orange contains a variety of phytochemicals. Hesperitin and Narigenin are flavonoids found in orange. Narigenins is found to have a bio active effect on human health as anti inflammatory, anti tumour and blood clot inhibiting properties as well as strong antioxidant effects [7].

Oranges also contain very good levels of vitamin A, which is required for maintaining healthy mucus membranes and skin and it is essential for vision. It is also a very good source of B-complex vitamins such as thiamin, pyridoxine and folates. These vitamins are essential in that the body requires them from external sources to replenish. Orange fruit also contains a very good amount of nutrients like potassium and calcium. Potassium is an important component of cell and body fluid that help control heart beat rate and blood pressure through countering sodium action [8]. Fibre in the fruit helps to prevent atherosclerosis (hardening of the arteries). A class of components found in the citrus pulps, called polymethoxylated flavones (PMFs), has the capability to reduce cholesterol levels [9].

Orange Pulp

In addition to the skin, which is an important source of fibre in most fruits, the pulpy part of the fruit is also a source of fibre, and other nutrients. The orange pulp contained total pectin 26.0 to 45.6 %, neutral detergent fibre, 15.8 to 31.0 % and crude fibre, 9.9 to 20.6 % [10]. The white pulpy part of the orange is the primary source of its flavonoids. When the pulpy white part of the orange is removed in the processing of orange juice the flavonoids in the orange are lost in the process. This loss of flavonoids is one of the many reasons for eating the orange in its whole food form [11].

Dietary fibre is the indigestible portion of plant foods. It is metabolically inert, absorbing water as it moves through the digestive system, easing defecation [12]. The main action of dietary fibre is to change the nature of the contents of the gastrointestinal tract, and to change how other nutrients and chemicals are absorbed. Soluble fibre binds to bile acids in the small intestine, making them less likely to enter the body, this in turn lower cholesterol levels in the blood [13].

Soluble fibre also attenuates the absorption of sugar, reduces sugar response after eating, normalizes blood lipid levels and once fermented in the colon, produces short-chain fatty acids as by products with wide-ranging physiological activities [12]. Dietary fibre is nevertheless regarded as important for the diet, with regulatory authorities in many developed countries recommending increases in fibre intake [14-15]. The short chain fatty acids produced are involved in numerous physiological processes promoting health [16]. These include:

- Stabilize blood glucose levels by acting on pancreatic insulin release and liver control of glycogen breakdown.
- Suppress cholesterol synthesis by the liver and reduce blood levels of low density lipoprotein cholesterol and triglycerides responsible for arthrosclerosis [16].
- Lower colonic pH (raises the acidity levels in the colon) which protects the lining from formation of colonic polyps and increases absorption of dietary minerals [17].

Much use has not been made of the orange pulp separately, but it can be used creatively in the kitchen. Recipes using orange pulp include oranges and kiwi cocktail recipe and fruit salad with orange pulp dressing e.t.c.

Ingredients in biscuit making

Flour: This is the powder obtained from grinding a cereal grain. Wheat flour is by far the most common. All flours are composed largely of starch and protein, but wheat flour is distinctive in that it has very high levels of a class of proteins known collectively as gluten. When dough is made from wheat flour and water, the gluten develops into a thick, cohesive, elastic mass, when placed in an oven, it puffs up to many times its original volume and sets with a light airy texture (Humphey-Talor, 2009). The characteristics and general quality of flour depends on.

1. The wheat variety and conditions under which the wheat has grown. This affects the quality and quantity of gluten in the grain.
2. The milling process: This determines the degree of separation of the bran and endosperm, as well as the particle size of the flour.
3. Additives and special treatments used by the miller to produce flour mixes with special characteristics.

Fat: Fat has five major roles in baking. How well it will perform each of these functions depends largely on the slip point, the temperature at which the fat just begins to melt. In general the slip point should be at least 5 ^{0}C above the proving temperature of the dough. The roles of fat are as follows:

Shortening: Fat weakens or shortens a dough by weakening its gluten network, resulting in the baked product being soft, breaking easily and having a more tender mouth feel.

Creaming: Fat can trap air during beating and mixing producing a batter that consist of masses of tiny air bubbles trapped within droplets of fat.

Layering: In puff pastry, fats which are soft over a wide temperature range are used. These can be spread between pastry layers and will separate them during cooking giving a layered pastry.

Flavour: Usually the fats used should have a bland flavour to prevent them from changing the flavour of the finished products [1].

In addition, the fat chosen needs to be able to form an emulsion, with the other ingredients in the batter or dough [19].

Sugar: Sugar is most commonly thought of as a sweetener, but in baked goods it is also involved in several other processes. Sugar undergoes a series of complex browning reactions above 160 ^{0}C, and the products of these form the brown crust of many baked goods. The reactions are known as maillard reactions, and are essentially amino acid catalysed caramelisation reactions in which a sugar aldehyde or ketone is converted to an unsaturated aldehyde or ketone. In non-fermented goods such as biscuits, large quantities of sugar can be added. This improves the keeping quality of the biscuits as well as sweetening them. The sugar usually used is pure sucrose such as castor sugar. Occasionally impure forms such as golden syrup, honey and brown sugar are used to give the baking a particular flavour.

Baking Powder: Baking powder is essentially a mixture of $NaHCO_3$ (sodium bicarbonate) and a weak solid acid or acid salt. When the mixture dissolves in water and the temperature is raised, CO_2 is released according to the equation

$$NaHCO_3 + \underset{\text{(from the acid)}}{H^+} \longrightarrow Na^+ + H_2O + CO_2$$

When baking powder is used rather than baking soda, the by-products are less alkaline and thus they have no undesirable effects on the taste of the product.

Salt: Salt is added to enhance the flavour of baked goods and to toughen up the soft mixture of fat and sugar that is to make dough more elastic [19].

Materials and Methods

Material Procurement

The sweet orange fruit was purchased from Mini market University of Maiduguri Borno State. Wheat flour, sugar, margarine, eggs and baking powder were purchased from Monday market Maiduguri Township, Borno State.

Preparation of orange pulp flours

The fruits were washed thoroughly with a clean water to remove dirt and adhering extraneous materials. It was peeled manually with a sharp kitchen knife in Chemistry laboratory of the University of Maiduguri. A laboratory extractor was used to extract the juice and the seeds removed. The pulp were cut into tiny pieces and then dried in the laboratory at room temperature to a constant weight. It was milled in attrition mill and sieved with muslin cloth to obtain the flour samples. The flow diagram for the preparation of orange pulp flours can be seen in Fig. 1.

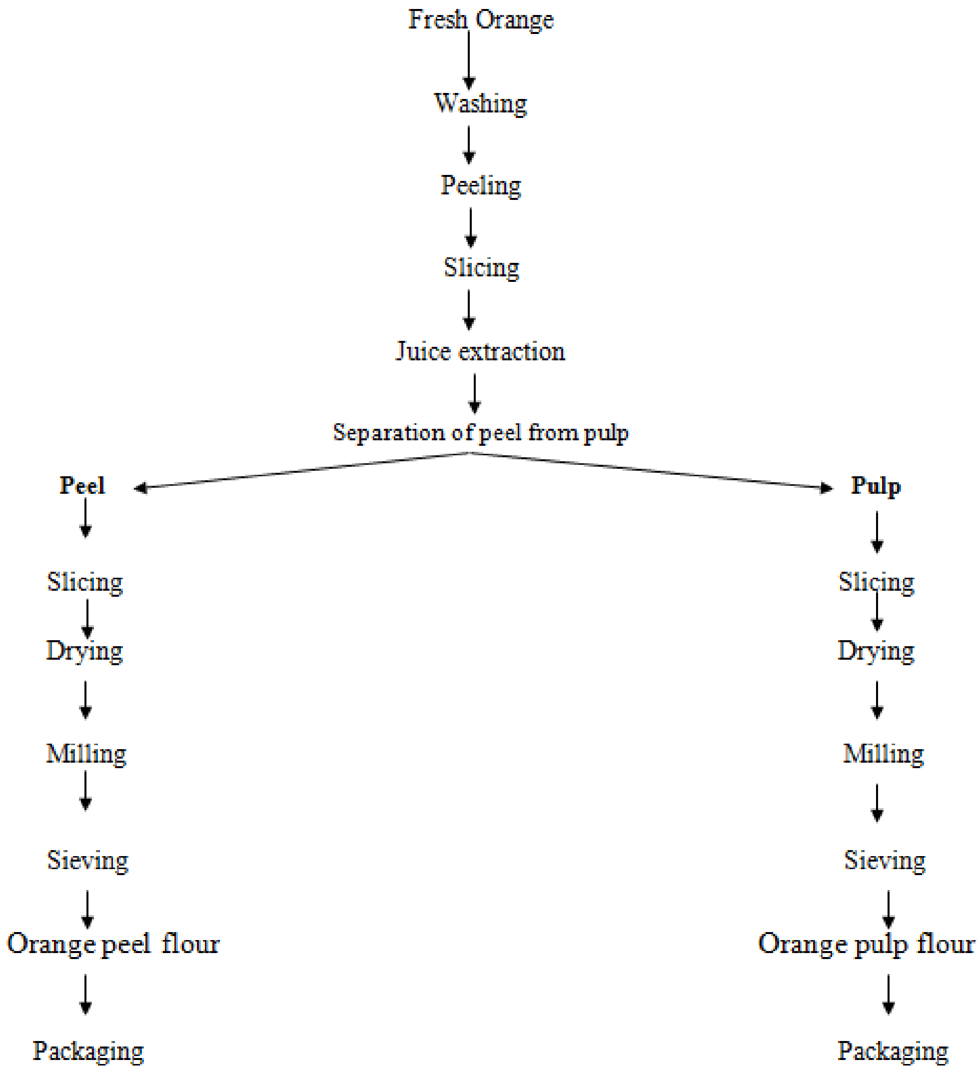

Figure 1: Preparation of orange peel and pulp flours

Flour blending

Ten, Fifteen and Twenty percent of the orange pulp flour was used to substitute 90, 85 and 80 % of wheat flour respectively in a food blender operated at full speed for 10 minutes.

Production of biscuit

The basic recipe that was used for biscuit production is shown in Table 1.

Table 1: Recipe for biscuit production [1]

Ingredient	Amount (g)
Flour	100
Margarine	22
Beaten egg	10
Baking powder	1.8
Water	45(ml)
Sucrose	20
Salt	0.3
Powdered milk	5

The ingredients were weighed out. Dry ingredients were mixed together. The fat was rubbed in and mixed until dough was formed. The resultant dough was kneaded and rested for about 5 minutes. The rested dough was rolled out into sheets and cut into shapes, using biscuit cutters. The dough was placed on well greased baking trays and baked for 10 to 15 minutes in an oven pre-heated to 200 °C, allowed to cool, then packaged in high density polyethylene bags in an air tight container. The flow diagram for the production of biscuit is shown in Fig. 2.

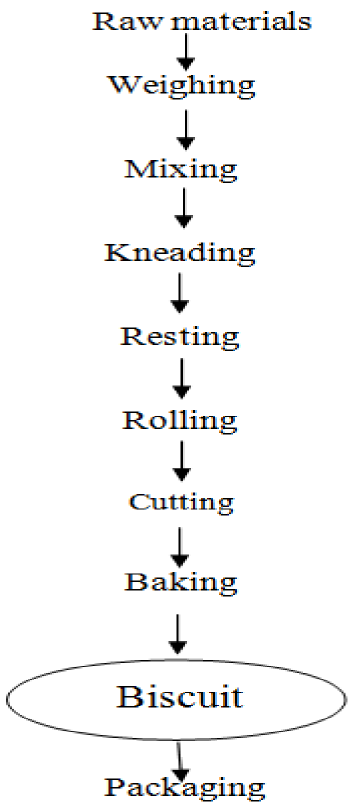

Figure 2: Production of biscuit

Sensory Evaluation

The biscuit samples prepared with 10, 15 and 20 % orange pulp flours including the control made from 100 % wheat were subjected to sensory evaluation and were assessed by laboratory Technician of Department of Pure and Applied Chemistry, University of Maiduguri, Borno State Nigeria. Quality attributes such as colour, flavour, texture, taste and overall acceptability were evaluated as described by Ihekoronye and Ngoddy [6].

Proximate Analysis

Moisture content determination

Moisture content was determined by the hot air oven method described by AOAC [20]. Two grams of the sample was weighed into crucible of known weight and placed in the oven at 105 ^{o}C for 4 hours. The samples were removed from the oven and placed in a desiccator to cool before weighing. The crucible was put back into the oven and weighed again until constant weight was recorded. The loss in weight from the original sample weight was calculated as the moisture content.

$$\%\,Moisture\,content = \frac{Weight\ loss}{Weight\ of\ sample} \times \frac{100}{1}$$

Crude Protein determination

The protein content was determined by the micro-Kjeldahl method as described by AOAC [20]. The sample (1 g) was digested in Kjeldahl digesting system. The digested sample was cooled and then distilled into a flask containing 5 ml of 2 % boric acid solution and few drops of methyl red indicator. The distillate was diluted with distilled water followed by the addition of about 5 milliliter of 60 % sodium hydroxide solution.

The distilled sample was titrated against 0.l m HCl solution. A blank titration was carried out. The percentage nitrogen content was calculated as:

$$\%\,Nitrogen = \frac{Vs - Vb \times N \times 14}{1000 \times Weight\ of\ sample} \times \frac{100}{1}$$

Where:

Vs and Vb = volumes of acid required to titrate the sample and the blank, respectively.

N = Normality of the acid

The protein content will be calculated as:

% Protein = % N x 6.25, where 6.25 is a conversion factor.

Ash Content Determination

Ash content was determined by the method of AOAC [20]. The ash content was determined after incineration of 2 g of the sample in a muffle furnace at 550 ^{o}C for 2 hours until a light gray ash was obtained. It was cooled in a desiccator, weighed and calculated using the formula:

$$\%\,Ash = \frac{Weight\ of\ ash}{Weight\ of\ sample} \times \frac{100}{1}$$

Fat Content Determination

The fat content was determined using the Soxhlet extraction method described by AOAC [20]. A Soxhlet extractor with a reflux condenser and a 500 ml round bottom flask was fixed. Two grams of the sample was weighed into a thimble and sealed with cotton wool. The assembled soxhlet apparatus was allowed to reflux for 6 hours and the petroleum ether evaporated into a container for reuse. When the flask was free of ether, it was dried at 105 ^{o}C for one hour in an oven. It was cooled in a desiccator and weighed. The percentage fat content was calculated as:

$$\%\,Fat = \frac{Weight\ of\ \ fat}{Weight\ of\ sample} \times \frac{100}{1}$$

Crude Fibre Determination

The crude fibre was determined according to the method of AOAC [20]. Petroleum ether was used to defat 2g of sample. This was put in a beaker containing 200 ml of 1.25 % H_2SO_4, boiled for 30 minutes, filtered through muslin cloth on a fluted funnel and was washed with boiling water until it was free of acid. The residue was returned into 200 ml boiling NaOH and allowed to boil for 30 minutes. It was further washed with 1 % HCl and then with boiling water to free it of acid. The final residue was drained and transferred to silica ash crucible (porcelain crucible) and dried in the oven to a constant weight and cooled. The crude fibre content was calculated as:

% Crude fiber = loss in weight after ignition x 100.

Carbohydrate Determination

Carbohydrate content of the samples was calculated by difference as described by AOAC [20]

% Carbohydrate = 100 – (% moisture + % protein +%ash +% crude fibre + % crude fat)

Calorific Content Determination

Calorific content was calculated using water factor method as described by Osborne and Voogt [21]. The values obtained for protein, fat and carbohydrate were used to calculate the calorific content of the samples as expressed below:

Calorific value (Kcal/100g) = (PX4.0) + (FX9.0) + (CX3.75).

Where: Protein content (%) = P, Fat content (%) = F and Carbohydrate content (%) = C

Proximate Composition of Biscuits

The proximate composition of biscuits supplemented with orange pulp flours are shown in Table 2. The biscuits which contained 10 % orange pulp flour had the highest moisture content of 8.85 %. The moisture contents of the wheat biscuit and the biscuit containing 10 % Orange pulp flour were 7.08 and 8.44 %, respectively. The highest moisture content of the biscuit containing orange pulp may be attributed to the higher moisture content of the orange pulp flour. The moisture contents of these biscuits were higher than 6.40 % reported by Youssef and Mousa [22] for biscuit supplemented with 10 % Baladi orange flour. Biscuits are generally low in moisture. The low moisture levels of the orange based biscuits would ensure shelf stability. The moisture content of a food is of significance to shelf life and packaging.

Table 2: Proximate composition of biscuits supplemented with orange pulp flours (%)

Biscuit	Moisture	Fat	Protein	Crude Fibre	Ash	Carbohydrate	Energy (Kcal/100g)
Wheat	7.08^{c}±0.08	16.78^{a}±0.07	15.19^{a}±0.04	1.33^{c}±0.19	1.23^{c}±0.03	60.73^{a}±0.21	439.52
Wheat-orange pulp	8.85^{a}±0.05	11.28^{c}±0.06	12.84^{c}±0.04	11.22^{a}±0.03	1.81^{b}±0.01	53.78^{b}±0.04	354.56

Values are means ± SD of triplicate determinations. Means within the same column with different superscripts were significantly different (p<0.05). Wheat- orange pulp biscuits contained 10 % orange pulp flour.

The biscuit produced from 100 % wheat flour had fat content of 16.78 %. The incorporation of orange pulp flours decreased the fat content of wheat flour biscuit to 11.28 %. This could be attributed to the low fat content of the orange pulp flours. Fats are integral part of biscuit, being the second largest component after flour in soft dough biscuits [1]. Fats shorten dough by weakening the dough gluten network. This results in soft biscuit which breaks easily and with a more tender mouth feel. Fat also gives a softer texture to biscuits and helps prevent the CO_2 bubbles from escaping from the dough too soon [23]. Biscuits are a rich source of fat and carbohydrate, hence are energy giving foods [24].

The protein content of the biscuit prepared with 10 % orange pulp flour was 12.84 %, a value lower than 15.19 % for wheat flour biscuit. The low protein content of the orange peel flour may have contributed to the lower protein content of its biscuit. The protein content of the biscuit containing 10 % orange pulp flour was higher than 7.44 % [22] and 10.98 % [22]. These differences may be attributed to the differences in the recipes used for the production of the different biscuits.

The addition of orange pulp flours increased the fibre content of the biscuits significantly (p<0.05). The 100 % wheat flour biscuit had fibre content of 1.33 %, a value which increased to 8.17 % and 11.22 % in biscuits containing 10 % orange pulp flours. People who already have diverticulosis often find that increased fibre consumption can alleviate symptoms, which include constipation and or diarrhea, abdominal pain, flatulence and mucus or blood in the stool [26].

The ash contents of the biscuits ranged from 1.23 % to 2.13 %, with the 100 % wheat flour biscuit having the lowest value of 1.23 %. The higher ash content of biscuit produced with orange pulp (1.81 %) may be attributed to the higher ash content of the orange pulp flour.

The 100 % wheat flour biscuit had the highest carbohydrate content of 60.73 %. This value was followed by that of the biscuit prepared with 10 % orange pulp flour. Biscuit produced with 100 % wheat flour had the highest energy value of 439.52 Kcal. The energy value of a food is related to its protein, fat and carbohydrate contents. The higher protein, fat and carbohydrate contents of the wheat biscuits may thus have contributed to its higher energy value in relation to those of the orange based biscuits. Biscuit is an energy food which is taken mostly in between meals by both young and old [27].

Conclusion

This research showed that flours can be produced from sweet orange pulp. Acceptable biscuits were produced from wheat flour supplemented with 10 % orange pulp flour. Storage did not adversely affect the sensory properties of the biscuits containing orange peel and pulp flours. The peroxide values of the biscuits increased slightly on storage. Further increases will result in oxidative rancidity.

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