Nat. Volatiles & Essent. Oils, 2022; 9(2): 745-754

NVEO
Natural Volatiles &
Essential Oils

Quality Characteristics Of Biscuits Made With Wheat, Unpolished Rice And Soyabean Flour

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Abstract

A study was conducted to evaluate the quality characteristics of wheat flour biscuits supplemented with soybean and unpolished rice blended flour at varying percentages of 4%, 10%, 20%, 30%, and 8%, 30%, 40%, and 50% respectively. Prepared biscuits were subjected to nutritional and sensory analysis to evaluate their suitability of the biscuits for consumption. Ash, fat, fiber, and Protein content of biscuits increased as the proportion of soybean and unpolished rice flour increased, with values of 1.50%-6.34%, 1.55%-7.69%, 0.88%-1.12%, and 14.42%-20.41% for 10%, while wheat flour biscuits had the lowest values of ash 1.50%, fat 2.5%, fiber 0.85% and protein, 12.30%. With a comparable increase in the amount of soybean and unpolished rice flour, the moisture and carbohydrate levels were reduced. The prepared biscuits' were assessed and evaluated using a nine-point hedonic scale ranking system. The sensory analysis revealed that there were no significant ($p<0.05$) variations in aroma, texture, taste, and overall acceptance between the control sample biscuit and the supplemented biscuit with 4% and 8% soybean and unpolished rice flour incorporation, however, there were significant differences between the control sample biscuits and the composite biscuit samples AB2, AB3, AB4, and AB5 in all the parameters assessed. Biscuits fortified with 4% and 8% soybean and unpolished rice flour was highly rated.

Keywords: wheat flour, composite flour, biscuits, organoleptic attributes, overall acceptance

Introduction

Consumers today enjoy bakery items with a good nutritional profile, sensory features, and texture, and they are popular among all age groups (Nagi et al., 2012). Biscuits are one of the fastest-growing areas of bakery products, owing to rising customer demand for convenience foods (Massodi and Bashir, 2012). Biscuits' extended shelf life, superior eating quality, and appealing look allow for large-scale production and distribution (Saleh, et al., 2012). Wheat, on the other hand, is a common ingredient in biscuits and contains few important amino acids such as lysine, methionine, and threonine (Jiang et al., 2008).Gluten, a protein contained in wheat, has also increased consumer worry about potential health problems caused by consuming bakery items in recent years (Gujral et al., 2003). Cereal bran, legume husk, and other possible sources of dietary fibre are being investigated in food processing around the world due to the health advantages of fiber (Bose and Shams-ud-Din, 2010). Biscuits are high in carbohydrate, fat, and calories but poor in fiber, vitamins, and minerals, making them unfit for everyday consumption (Serrem et al. 2011). Furthermore, biscuits contain only 6–7% protein (Agarwal 1990). This can be accomplished by fortifying biscuits with protein-rich foods such as soybean and unpolished rice.

Soybean (Glycine max) seeds are the highest in food value of all plant foods consumed in the world, with a protein content of 40-45 percent (Kure et al. 1998). It also contains a lot of calcium, iron, phosphorus, and vitamins. It is the only grainone can get all of the essential amino acids from. Soybeancontains high protein when used in food application to meet the needs of people who are deficient in proteins in their systems (Mooriya 2003). In spite of this, several high protein energy foods have been manufactured industrially in various regions of the world to help reduce the protein energy malnutrition in children (Mooriya 2003).Soybeans have twice the protein content of other pulses, four times the protein content of wheat, six times the protein content of rice grain, and four times the protein content of milk. Soybeans include 3% lecithin, which is beneficial to brain development (Akubor and Ukwuru 2005). Soy products help to lower the risk of heart disease. Regular use of soy cuisine slows the aging process and enhances children's mental and physical abilities, memory, and hemoglobin levels (American Soybean Association 2004).

Unpolished rice has a higher nutritional value than refined or polished rice because of its outer coating, which contains extra minerals and protein. It includes 8% protein and is high in amino acids such as thiamine and niacin (Acheampong, 2011). Brown rice flour (BRF) is used in bread products to give them a distinctive nutty flavour and texture (Islam et al., 2011).

Furthermore, unpolished flour is gluten-free and has unique characteristics such as bland flavor, ease of digestion, and easily digestible carbs, making it a perfect ingredient for the development of bakery items, especially for celiac patients (Mir et al., 2015). The majority of the cereals produced in Ghana are thrown away due to low patronage and underutilization. Despite its traits or qualities, unpolished rice has low patronage among Ghanaians, even thoughthe fact that it is available in the local market.This condition has resulted in large post-harvest losses, which act as a deterrent to local unpolished rice growers. As a result, there is a need to add value to unpolished local rice in toorder to make it more appealing and increase patronage by changing and employing it in composite flour so that it may be used for more than just boiled rice.

The use of local underused crops like unpolished rice and soybean to enrich cereal-based diets has gotten a lot of attention. There has been a trend to add bran from other sources, such as high protein-fiber sources, into cereal goods (Hegazy and Ibrahim, 2009). O'Connor et al. (2003) found that high dietary fiber intake is linked to a lower risk of coronary heart disease, colon cancer, and bowel problems. The addition of unpolished rice and soybean flour to biscuits has been highlighted for its high levels of dietary fiber and protein, making the items excellent for human consumption (Alobo, 2007). The objective of the study was to carry out the proximate composition and consumer acceptability of biscuits made of wheat, soybean and unpolished rice.

Materials and Methods

Raw materials

Refined wheat flour, margarine, sugar, vanilla extract and milk powder were bought from a supermarket in Central Market, Kumasi, Ghana. The raw materials such as soybean and unpolished rice were also procured from wholesale trader at Tafo Market.

Preparationof soybean flour

The IITA (1990) method was used to grind the soybean seeds into flour.Stones, debris and other materials were removed from the soybean. The seeds were washed with portable water, drained and dried for 2 hours in the sun. It was then blended in a food processor blender into flour. The flour wassieved through a 0.25mm sieve and kept refrigerated at 4°C to avoid spoiling, particularly rancidity, until they were used.

Product Formulation and preparation

Unpolished local rice flour concentration was combined with wheat flour to make the biscuits. Five (5) products, AB1, AB2, AB3, AB4, and AB5, were developed with unpolished rice flour substituting similar amounts of wheat flour at levels of 0, 25, 50, 75, and 100 percent. Table 1 displays the product percentage composition. Apart from wheat flour and unpolished brown rice flour, which were used in different amounts for each of the five items, all other components were used at the same levels. In a basin, unpolished rice flour, wheat flour, and other components were precisely weighed. The fat was rubbed in until fine bread crumb texture was achieved. Following that, the sugar was added. To bind the mixture into a stiff paste, one egg was beaten and added. The dough was then smoothed out, cut into shapes, and placed on a baking pan that had been lightly buttered. It was baked for 15 minutes at 140 degrees Celsius in a moderate oven, and then chilled on racks to room temperature.

Table 1: Formulation of ingredients for wheat-unpolished rice- soybean biscuits

Ingredients	AB_1	AB_2	AB_3	AB_4	AB_5
Soft wheat flour (g)	100	80	60	40	20
Soya bean flour (g)	0	4	10	20	30
Unpolished rice flour (g)	0	8	30	40	50
sugar (g)	100	100	100	100	100
Margarine (g)	50	50	50	50	50
Eggs (large size)	1	1	1	1	1
Baking powder (g)	0.5	0.5	0.5	0.5	0.5
Milk powder (g)	10	10	10	10	10
Vanilla extract(g)	1	1	1	1	1

AB_1(100% wheat flour), AB_2(80% wheat flour, 4% unpolished rice 8% soybeans flour), AB_3 (60% wheat flour, 10% soybeans flour and 30 % unpolished rice flour), AB4 (40% wheat flour, 20% soybeans flour and 40% unpolished rice flour) and AB_5(20% wheat flour, 30% soybeans flour and 50% unpolished rice flour)

Proximate analysis

Moisture, ash, fat, fiber, Protein and carbohydrate contents of the 100% wheat and composite biscuits were determined using AOAC standard methods (AOAC, 2005).

Determination of moisture content

The moisture content of the samples was evaluated by weighing 5 g of each sample into labeled cans of known weights (W1). The samples in cans (W2) were baked for 6 hours at 105°C, cooled in desiccators, and weighed again (W3). Moisture loss was considered to be the cause of the weight differential.

Determination of ash content

The samples' ash content was evaluated by placing roughly 5g in a known-weight plate (W4) and drying for 4 hours at 105°C. In a muffle furnace at 550°C, the sample in a dish was ash till white or grey ash formed. It was chilled before being reweighed (W6). The ash content was calculated as a percentage.

Determination of fat content

The Soxhlet extraction method was used to determine fat content. Fat was determined using this approach, which involved extracting dried materials (food samples) in a continuous extraction system with a light petroleum fraction. The extract was dried and weighed after the solvent was removed.

Determination of fiber content

The enzyme-modified, neutral detergent fiber (NDF) method was used to determine the fiber content of the biscuits. Dried biscuit samples were processed with normal NDF techniques until fiber-containing residues were filtered and rinsed with water after the fat content was recovered using the Soxhlet extraction method. At 37°C, the filtered residues were incubated overnight with a porcine á –amylase solution. After incubation, the residues were filtered, washed thoroughly, and dried. As a filtered residual, the NDF was determined.

Determination of protein content

Using a protein factor of 6.25, the protein was calculated using the Kjedahl technique. A digestion tube containing around 1.2g of sample was weighed, and H2S04 98 percent was added using a dispenser. For around 30 minutes, the tube was placed in a warmed digester at 420°C until a clear solution was formed. The digester tube was withdrawn, cooled, and diluted with water before being placed in the distillation unit. Under the condenser output, a conical flask holding 25 mL of boric acid (with indicator) was inserted. In the digesting tube, around 25 mL of 40% sodium hydroxide (Na0H) was poured, and distillation was carried out for 5 minutes. The ammonium borate solution was titrated to a purplish-grey endpoint using 0.1M tetraoxosulphate (VI) acid. Percentage nitrogen (%N2) was calculated.

Determination of carbohydrate content

The following equation was used to calculate the amount of accessible carbohydrate::

Total carbohydrate (g⁄100 g of sample) =(100 − (moisture + ash + protein + fat + crude fiber).

Statistical analysis

The Statistical Package for the Social Sciences was used to analyze the data (SPSS version 15.0 SPSS Inc. Chicago, Illinois, U.S.A). The data was presented as a percentage with a mean and standard deviation. The significance of the results was determined using a one-way ANOVA. The T-test was used to differentiate the means.

Sensory analysis

A trained 30-member panel assessed sensory qualities such as taste, colour, texture, flavour, and overall acceptability of the biscuits produced. The degree of like and dislike for biscuit preference was measured using a nine-point hedonic scale.

Results and Discussion

Table 2 shows the moisture, ash, fat, fiber, protein, and carbohydrate composition. As indicated in table 2, moisture content ranged from 9.75% to 13.05% as soyflour content increased from 4%, 10%, 20%, 30%, and 8%, 30%, 40 %, and 50 %. Biscuit sample AB1 had the highest moisture level (13.05%), while the composite samples (AB2, AB3, AB4 and AB5) recorded 12.24%, 11.83%, 10.89%, and 9.75%, respectively, with biscuit sample AB5 (20% wheat flour, 30% soybeans flour and 50% unpolished rice flour) having the least moisture content (9.75%). It is possible that the low moisture content was due to the fact that soy flour and unpolished rice flour had a higher amount of total dry solid with good blending characteristics than wheat flour.Due to the low moisture content of the soybeans and unpolished rice flour, the moisture level of the biscuit reduced as the amount of soy and unpolished rice flour in the blend increased. This is consistent with the findings of Sutharshan et al. (2001), who found that increasing the proportion of soy flour decreases the moisture content of soybean flour augmented biscuits. Between the control biscuit and the composites, there were significant variations (P<0.05).

With an increase in the amount of soy and unpolished rice flour, the ash level increased from 1.5% to 6.34%. The biscuits prepared from a flour mixture including 40% wheat flour, 20% soybeans flour and 40% unpolished rice flour had the highest ash content, whereas the biscuits made from 100% wheat flour had the lowest (1.50%). The ash level of the flour gradually increased as the quantity of soy and unpolished flour increased. The ash content aids in determining the amount and kind of minerals in food, which is significant because mineral content can affect food physiochemical qualities as well as microbe development.A prior study by Akubor and Ukwuru (2005) contradicted the findings, although they were in agreement with the findings of Siddiqui et al. (2003) and Ayo et al. (2014) on the use of soy flour in biscuits.

Soybean is a protein-rich oil seed that is currently the world's most popular edible oil source. Soybean is high in polyunsaturated fats, including the two necessary fatty acids linoleic and linolenic acid, which the body cannot generate. Essential fatty acids are necessary for human health because they help the body absorb crucial nutrients (Hegstad 2008). With an increase in soybean flour from 4% 10% 20% to 30%, the fat content of the biscuits increased from 2.45 to 7.69% (Table. 2). Biscuit sample (AB_5)recorded highest fat content (7.69%) and was significantly different from the control biscuit sample (AB1) with 2.45%. The increase in fat content could be attributed to the addition of soybean flour to the flour blend. This could be due to the fact that soy flour has a higher fat content than wheat flour. Akubor and Ukwuru's (2005) findings are consistent with the findings of the present study Soy flour has 20–24 percent fat, whereas wheat flour has 0.9–1.1 percent fat, the majority of which is unsaturated, according to Reddy (2004).

With increased soy flour supplementation, the fiber content of the biscuit increased from 0. 85% to 1.12%. Biscuit sample AB_5 (20% wheat flour, 30% soybeans flour and 50% unpolished rice flour) had the most fiber (1.12%), whereas control AB_1 (100% wheat flour) biscuit had the least (0.85%). Ayo et al. (2014) showed similar results in increased fiber content when malted soy flour was added to biscuit manufacture. According to a study on soy flour supplementation in the making of bread by Ndife et al. (2011), the rise in fiber content could be attributable to the increase in soy flour in the blended flour. Dietary fiber is now widely acknowledged to play a substantial role in the prevention of a variety of diseases, including cardiovascular disease, constipation, irritable colon, cancer, and diabetes, according to well-documented studies (Slavin 2005; Elleuch et al. 2011). As a result, this wheat, soya and unpolished rice enriched biscuits may aid in the prevention of such occurrences.

Soy and unpolished rice flour are used as inexpensive protein supplement in biscuits, bread, pasta, and other cereal goods because soybean protein provides an excellent nutritional complement to lysine-limited cereal protein (Hegstad 2008). With the increase in soybean and unpolished rice flour, the protein content of the biscuits went from 12.30% to 20.41%. Biscuit sample AB5 (20% wheat flour, 30% soybeans flour and 50% unpolished rice flour) had highest protein content (20.41%) and the least protein content (12.30%) was found in biscuit sample AB1 (100% wheat flour). The increase in protein content could be attributed to the addition of soybean flour to the flour blend. Because soybean is a high-protein legume, adding soy flour to the biscuits boosts the protein level. Because soy flour boosts protein, fat, and vital amino acid content, it has a better chance of combating protein-calorie malnutrition (Akubor and Ukwuru 2005).

The carbohydrate content of the biscuits ranged from 78.74% to 65.62% with control biscuit having the highest carbohydrate content (65.62%) while biscuit sample AB_5 (20% wheat flour, 30% soybeans flour and 50% unpolished rice flour) recorded the lowest carbohydrate content (54.78%). As the amount of soy and unpolished rice flour supplemented increased, the carbohydrate content decreased. Ayo et al. (2014) showed a similar tendency in a decrease in carbohydrate content when malted soy flour was used in the making of biscuits. The low carbohydrate content of added soy and unpolished rice flour 4% to 10%, 20%, 30%, and 8%, 30%, 40 %, and 50 %, could explain the decrease in carbohydrate content (Gopalan et al. 1999).

Table 2: Proximate composition of wheat-soybean-unpolished rice flour biscuits

Sample	**Moisture**(g/100g)	**Ash**(g/100g)	**Fat**(g/100g)	**Fibre**(g/100 g)	**Protein**(g/100 g)	**CHO**(g/100 g)
AB1	13.05^a	1.50^e	2.45^e	0.85^e	12.30^e	65.62^a
AB2	12.24^b	1.62^d	4.97^d	0.93^d	14.49^d	62.68^b
AB3	11.83^c	1.55^c	3.94^c	0.88^c	14.42^c	62.63^d
AB4	10.89^d	6.34^b	5.84^b	1.00^b	17.21^b	65.74^c
AB5	9.75^e	4.22^a	7.69^a	1.12^a	20.41^a	54.78^e

Values represent means and standard deviation replicate readings for various parameters. Values in the same column with different superscripts are significantly different ($p>0.05$). Keys: AB_1(100% wheat flour), AB_2(80% wheat flour, 4% unpolished rice 8% soybeans flour), AB_3 (60% wheat flour, 10% soybeans flour and 30 % unpolished rice flour), AB4 (40% wheat flour, 20% soybeans flour and 40% unpolished rice flour) and AB_5(20% wheat flour, 30% soybeans flour and 50% unpolished rice flour)

Sensory of wheat-soybean-unpolished rice flour biscuits

Table 3 presents the sensory analysis of wheat, soybean and unpolished rice biscuits. The sensory scores of biscuits supplemented with 4% to 10%, 20%, 30%, and 8%, 30%, 40%, and 50% soy and unpolished rice flour showed that with regard to colour, aroma, texture, taste, and overall acceptability, the sensory characteristics of AB1 (100% wheat flour) was the most accepted biscuit followed by sample AB2 with 4% and 10% soybean and unpolished rice flour. The findings revealed that there was no significant difference ($p<0.05$) between the most preferred biscuit (control) and the composite biscuit sample AB_2 (80% wheat flour, 4% unpolished rice 8% soybeans flour)

The term "colour" relates to a product's appearance. Due to its aesthetic appeal, it is one of the sensory aspects that consumers inspect when purchasing new products. The average colour score of the biscuits rises from 6.12% to 8.30%. Product AB1 (100% wheat flour) biscuit was rated very high on the hedonic scale, while the other products were satisfactorily ranked. As the amount of soy and unpolished rice flour in the biscuits increased, the average colour score decreased.Product AB1 differed significantly ($P <0.05$) from the other biscuit products, AB2, AB3, AB4, and AB5. Alice and Rosli (2005) found that when KuihTalamPandami (KTP) was mixed with 30-90% unpolished brown rice powder, the sensory score for colour was much lower than the control sample.Bunde et al. (2010), on the other hand, found no significant variation in colour between control biscuits and 10-40% unpolished rice flour biscuits. The low colour mean score for composite biscuits could be attributed to the composite flour's degrees of replacement. This is due to the fact that wheat flour aids in the formation of desired colours in baked goods.

A product's aroma is the sensation that the nose detects when it comes into contact with it (Potter and Hotchkiss, 1996). The aroma of the biscuits ranged from 6.87 to 8.40 with biscuit sample AB_1 (100% wheat flour) having the highest score for aroma (8.40) whereas, the least aroma score was AB_5 (20% wheat flour, 30% soybeans flour and 50% unpolished rice flour) with 6.87. It was observed that the aroma of the composite biscuits it was decreased with an increase in the substitution of soy and unpolished rice flour. This could be due to the beany flavour of soy flour (Akubor and Ukwuru 2005).

The texture of the biscuit indicates whether the surface is smooth or rough. The texture of the biscuits ranged from reduced from 6.46 to 8.50 with the control sample (AB1) having the highest score for texture followed by composite biscuit sample (AB2). As the amount of soy and unpolished rice flour used for the biscuits increased, its texture decreased.

Taste is the most important component in determining whether or not a product is acceptable, and it has the greatest impact on the product's commercial success. With the increased degree of soy and unpolished rice flour substitution, the taste score had likewise decreased from 6.48 to 8.62. The biscuit with 30% soybeans flour and 50% unpolished rice flour was considered the worst in terms of taste (6.48) whilethe mean value for biscuit sample AB2 (8.62) was the highest and was not significantly different ($p<0.05$) from the control sample AB1(100% wheat flour).

Overall acceptability is a critical measure in sensory evaluation since it encompasses a wide range of meanings. In terms of general acceptability, biscuit sample made with 4% soybeanflour and 8% unpolished rice flour was highest rated followed by the control (100% pineapple). There were no statistical differences between the accepted biscuit sample and the control.Consumers choose foods based on quality, which includes taste, aroma, texture, colour, and nutritional content, according to Potter and Hotchkiss (1996). Alice and Rosli (2015) and Islam et al. (2015) came to similar conclusions. As the amount of unpolished rice and soybeanflour substituted reduced, the level of acceptance increased as well.

Table 3: Sensory of wheat-soybean-unpolished rice flour biscuits

Sample	Colour	Aroma	Texture	Taste	Overall Acceptability
AB1	8.30	8.40	8.50	8.59	8.40
AB2	8.20	8.37	8.47	8.62	8.44
AB3	8.00	7.60	8.42	7.38	7.83
AB4	7.15	7.64	7.45	7.45	7.55
AB5	6.12	6.87	6.46	6.48	6.68

Values represent means and standard deviation replicate readings for various parameters. Values in the same column with different superscripts are significantly different ($p>0.05$). Keys: AB_1(100% wheat flour), AB_2(80% wheat flour, 4% unpolished rice 8% soybeans flour), AB_3 (60% wheat flour, 10% soybeans flour and 30 % unpolished rice flour), AB4 (40% wheat flour, 20% soybeans flour and 40% unpolished rice flour) and AB_5(20% wheat flour, 30% soybeans flour and 50% unpolished rice flour)

Conclusion

The study found that soybean and unpolished rice flour had equivalent carbohydrate, protein, and moisture contents to wheat flour. For all of the features, the sensory evaluation revealed that biscuits with 4% soybean and 8% unpolished rice flour received high ratings though, were not significantly different from the 100% wheat biscuit. The overall acceptability of the biscuits improved when soybean and unpolished local rice flour were added. The results of this study could help reduce wheat importation, improve the livelihood of farmers who cultivate soybean and brown rice as well as offer a variety of pastries to consumers.

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