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Valorization of Garden Egg (*Solanum gilo*) Fruits into Nutrient-Improved Biscuits: Chemical and Sensory Evaluation

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Abstract: This current study focused on the assessment of chemical and organoleptic properties of biscuits incorporated with milled fresh garden egg mash. After pulverizing whole garden egg fruits, the mash obtained was incorporated into wheat flour for biscuit production at the ratios of 0:100, 10:90, 20:80, 30:70 and 40:60 respectively. Formulated samples were subjected to proximate and mineral determinations using standardized methods. Biscuit samples were also presented before a twenty-member semi-trained consumer panel, who assessed the samples based on appearance, flavour, crispiness, taste, mouth feel and overall acceptability in in one hedonic taste session. Results from statistically analyzed data showed that moisture, ash, crude fibre, crude fat, crude protein and carbohydrate contents ranged between 4.13-5.29%, 0.85-2.25%, 0.59-6.22%, 18.69-22.37%, 11.18-13.6% and 54.25-60.00% respectively. Mineral content results showed a steady and significant ($p<0.05$) increase in sodium (30.50–55.40 mg/100g), potassium (180.78–261.30 mg/100g), magnesium (60.12–115.38 mg/100g), calcium (161.39–201.09 mg/100g), iron (10.12–19.21 mg/100g), phosphorus (63.25–107.40 mg/100g), and zinc (2.73–13.77 mg/100g) respectively. Mean sensory scores obtained from panelists indicate that all samples were desirable as they all scored above average, with overall acceptability ranging at 7.85 - 8.70. It was therefore concluded that the inclusion of garden egg mash at 20 – 30% will not only create a nutrient dense biscuit but also maintain consumer acceptability.

Keywords: *Biscuit; Garden Egg; Mash; Consumer Panel; Acceptability.*

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I. INTRODUCTION

Recently, food research has been focused on developing nutritionally healthier versions of foods such as alternatives to popular foods, enabling individuals to eat what they love to eat while preventing or improving diet-related conditions like diabetes, obesity, and some cardiovascular diseases [1]. One of the approaches used to achieve this is by including high-fiber ingredients or raw materials in food formulations; this is because fiber has been proven to support gut health and reduce the risk of several diseases [2]. Soluble and insoluble fibers are often obtained from plant sources like cereals, legumes, roots/tubers, fruits, and vegetables. Their known interaction with the gut microbiota as well as their inherent physical properties contribute to the advantages they offer when consumed.

In the human gut, human digestive enzymes are unable to breakdown and absorb fiber in the small intestine; thus, it passes down to the colon where it serves as a substrate for microbial fermentation by *Bifidobacteria* and *Lactobacillus*, producing acetate, butyrate, and propionate respectively. These are referred to as short-chain fatty acids. Their roles include serving as an energy source during metabolism, providing energy for cells in the colon, regulation of gluconeogenesis, synthesizing cholesterol, reduction of pH and inflammation, as well as maintaining gut barrier functions [3]. Apart from the above-mentioned, the presence of fiber influences bowel movements for easy emptying

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after digestion and also acts as a prebiotic, encouraging the growth of beneficial bacteria. They help increase insulin sensitivity, regulate the frequency of eating by regulating appetite through the gut hormone GLP-1, and help reduce excess cholesterol.

Conventionally, baked foods such as biscuits are often made from refined wheat flour, eggs, baking powder, butter, and other ingredients. They often come in several colors, shapes, and sizes exhibiting sweet or savory flavors. They are low in moisture, shelf-stable, and when packaged properly can remain unspoiled for a long period of time [4]. As a snack, biscuits are self-fed during and in-between meals and are globally consumed by almost everyone. They can also be reformulated or modified to suit the nutritional needs of specific individuals and populations [5, 6].

It is interesting to mention that the day-to-day consumption of biscuits and other snacks like bread, cakes, chips, pap, sodas, sweets, and others has been steadily increasing within low-, middle-, and high-income countries [7]. This information, therefore, provides food and nutrition researchers with data that guide them on nutrient improvement for such convenient foods with wide acceptability, as they can be used for interventions and other forms of nutritional support.

Traditional biscuits are often produced using refined flour and high levels of refined sugars, salt, saturated fats, and low micronutrients [8]. For such foods, health-conscious persons as well as those watching their foods for personal reasons try to avoid or limit their intake; sometimes when they do, they are filled with guilt and fear of these raw materials causing them to breakdown. Thus, the need to create healthier alternative biscuits cannot be overemphasized. This study harnessed the valorization of garden eggs and sought to convert postharvest losses due to perishability and lack of proper handling/management into ingredients for nutrient-improved biscuits.

Garden egg (*Solanum gilo*), locally referred to as *ika* by the Igalas, *igba* in Yoruba, and *yalo* by the Hausas of Nigeria, is one of the cheapest, important, and popular members of the genus *Solanum* grown all year round in West Africa, especially in riverine areas. Many locals prefer its fruits to those of other varieties like aubergine due to its natural ability to maintain its usually white or green pigment after peeling and chopping. The garden egg fruit plays significant functions during traditional rites in sub-Saharan African culture. The fruits are believed to command blessings, freshness, and fruitfulness like kolanut and are often provided as a token of goodwill during traditional festivals, royal outings and hostings, coronations, naming and marriage ceremonies, as well as other social events.

In terms of forms of consumption, they can be eaten fresh or raw (uncooked), boiled in seasoned water, steamed, or fried after mashing to serve as one of the ingredients for gravies, soups, stews, and vegetable sauces [9]. Sensory tasting research reveals that, while some species are slightly sweet, some are slightly bitter and some are bland in taste. Garden eggs are generally rich in moisture content, fiber, micronutrients, and some phytochemicals [10]. They have been used in many parts of the world as a food and medicine—these include West, East, and Central African countries as well as the Caribbean—and have also been shown to have numerous health benefits, including reducing inflammation and improving cardiovascular health, including all the benefits associated with consumed plant fiber [11].

Although some fiber biscuit varieties are currently found on the commercial shelf, there is little or no record of garden egg biscuits in both local and modern markets as well as literature. As people increase demand for nutrient-dense snack options, incorporating fiber-rich ingredients into biscuit formulations may provide a viable opportunity for nutrient improvement. While this strategy may be considered, the exploration of novel fiber sources like fresh garden egg fruits, which can be incorporated without compromising sensory qualities such as taste, texture, and appearance as well as avoiding synthetic ingredients in such inclusions, can be a welcome development.

The inclusion of fresh, high-moisture content fruit like garden egg may affect the dough structure of the biscuit, baking procedure, as well as final organoleptic quality of the product. Thus, this study, apart from valorization, also aimed at evaluating the chemical and sensory properties of biscuits incorporated with fresh garden egg fruit mash.

II. MATERIALS AND METHODS

➢ *Raw Material Procurement*

Raw materials for this study included all-purpose wheat flour, freshly harvested garden eggs, table sugar, baking powder, flavor, and other ingredients for biscuit production. These were all purchased from Anyigba Central Market, Kogi State. All other apparatus and equipment required for processing and analyses were obtained from the Food, Nutrition and Home Science Laboratory, Prince Abubakar Audu University, Anyigba (latitude about 6.33° N - 8.44° N and longitudes from 5.40° E - 7.49° E).

➢ *Production of Garden Egg Mash*

Garden egg mash was produced from fresh white garden egg fruits as described by Adeleke et al. [12] as shown in Figure 1. After reception, fresh fruits were sorted to exclude mechanically damaged as well as diseased fruits. They were then steeped and washed with room temperature clean tap water to clean them from dirt and loose soil particles and drained. With the aid of a clean sharp kitchen knife, each fruit was carefully cut into chunks to facilitate further processing. The fruits were then transferred into boiling water to cook for 15 minutes. This helped to shrink the fruits and reduce moisture content. After the cooking period, the fruits were quickly transferred to a clean colander and spread evenly to cool at room temperature. This was then followed by blending into a viscous mash with the aid of a high-speed processing blender to achieve a smooth consistency. This mash was stored in zip-lock plastic bags in a freezing condition (0°C) until further use.

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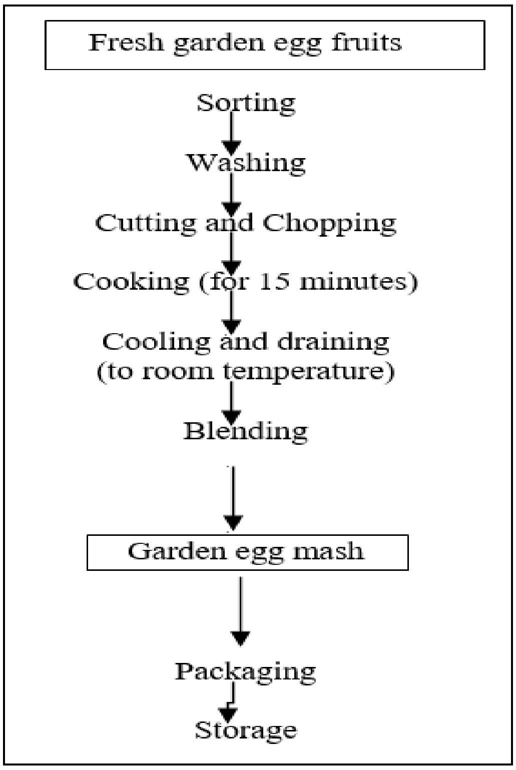

Fig 1 Flow Chart for the Production of Garden Egg Mash
Source: Adeleke et al. [12]

- *Sample Preparation*

Samples were formulated by incorporating garden egg mash at graded levels into wheat flour as shown in Fig 1. The ratio adopted for wheat flour and garden egg combination included 100:0, 90:10, 80:20, 70:30, and 60:40 respectively. Biscuits samples were then processed as described by Oloniyo et al. [13]. For each sample, standard quality of wheat flour was sieved, weighed, and mixed with other standard biscuit ingredients such as margarine, baking powder, sugar, and milk as well as the garden egg mash. All ingredients were thoroughly mixed to combine, after which minimal water was added to form a firm but soft dough. Furthermore, the dough was kneaded for a few minutes and wrapped up in a cellophane sheet to rest for 30 minutes. The dough was then cut into chunks and rolled, after which a shape cutter was used to cut into shapes and transferred onto greased oven trays for baking in a preheated oven at 200°C for 10 minutes. After baking, the biscuits were placed on a flat surface to cool at room temperature and then stored in airtight zip-lock plastic bags at 4°C prior to analysis.

- *Analytical Methods*

- *Proximate Analysis*

Standard measurements of each sample prepared were analyzed for moisture, crude protein, crude fat, ash, and carbohydrates contents according to the methods of analysis described by AOAC [8].

- *Minerals Analysis*

Standard measurements of each sample prepared were analyzed for sodium, potassium, magnesium, iron, and zinc as described by AOAC [8].

- *Sensory Evaluation*

Twenty semi-trained panelists were recruited based on voluntary consent from Food Science and Technology programme students of the department of Food, Nutrition and Home Sciences, Prince Abubakar Audu University, Anyigba. They were presented with the biscuit samples in a one–session hedonic testing to assess them based on the appearance, flavor, crispiness, taste, mouthfeel, and overall acceptability using a 9-point Hedonic scale in which 1 means extremely dislike and 9 means extremely like [14].

- *Experimental Design*

This study adopted a 4 x 1 factorial design in a randomized block design. A control sample of 100% wheat biscuit was studied alongside biscuits containing graded levels of garden egg mash, producing a total of five samples.

- *Statistical Analysis*

All data, apart from sensory evaluation scores (n=20), were recorded in triplicate. All data collected were analyzed statistically using SPSS version 23. One-way Analysis Of Variance (ANOVA) and Duncan Multiple Range Test with a level of significance of $p < 0.05$ were used to separate the differences in mean values.

III. RESULTS

- *Proximate Composition of Wheat-Garden Egg Biscuits*

The results of the proximate composition of biscuits produced from wheat flour and fresh garden egg mash blends are as presented in Table 1. The moisture content of the samples ranged between 4.13% (Sample 100:00) to 5.29% (Sample 60:40). Ash content increased significantly with garden egg inclusion from 0.85% in Sample 111 to 2.25% in Sample 555. Crude fiber content increased significantly from 0.59% in Sample 111 to 6.22% in Sample 555. Furthermore, fat content decreased with increasing garden egg inclusion, from 22.37% (Sample 111) to 18.69% (Sample 555). Crude protein content also showed an increase with increasing garden egg inclusion, from 11.18% (Sample 111) to 13.60% (Sample 444) before a slight drop to 13.28% in Sample 555. Carbohydrate content was highest in Sample 111 (60.00%) and reduced with increasing garden egg levels, down to 54.25% in Sample 555.

- *Mineral Composition of Wheat-Garden Egg Biscuits*

Table 2 presents the effect of garden egg mouth mash inclusion into wheat flour for the production of biscuit samples. Mineral properties were significantly ($P<0.05$) influenced, improving the nutrient quality of the product. There was a consistent improvement in sodium, potassium, magnesium, calcium, iron, phosphorus, and zinc as the proportion of garden egg increased from 0% to 40%.

Sodium content increased from 30.50 mg/100g (Sample 111) to 55.40 mg/100g (Sample 555). Potassium content also increased significantly from 180.78 mg/100g to 261.30 mg/100g. Similarly, magnesium increased from 60.12 mg/100g in Sample 111 to 115.38 mg/100g in Sample 555. Calcium content recorded a steady increase as well from 161.39 mg/100g to 201.09 mg/100g. Iron content in

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the formulated samples increased from 10.12 mg/100g (Sample 111) to 19.21 mg/100g (Sample 555), while phosphorus content increased from 63.25 mg/100g to 107.40 mg/100g. Finally, zinc levels improved from 2.73 mg/100g to 13.77 mg/100g.

➢ *Sensory Properties of Wheat-Garden Egg Biscuits*

In terms of sensory assessments, sample 111, which was the control sample, was scored as the best in terms of appearance (8.50), significantly (P<0.05) higher than Samples 222 and 333.

Flavor showed the highest value in 111 (8.40), the control sample, while sample 444 (7.30) was scored the least, significantly (P<0.05) lower than all others. Sample 555, however, shared some similarity with the control, while samples 222 and 333 showed no particular trend in perception.

In terms of mouthfeel, the control sample (111) also was most preferred and the panel preference declined with an increase in garden egg inclusion, though sample 333 maintained a high score. For the taste of the formulated samples, the control sample, though again significantly different from others and rated highest, was closely followed by samples 333 and 444 respectively. In terms of crispiness, no statistical difference (P>0.05) was observed across samples. Similarly, there were no statistically significant (P>0.05) differences across all samples in terms of texture, as all samples had the same superscripts. Mean scores for overall acceptability also revealed that the control sample was scored the highest, while samples 444 and 555 shared some similarities with the control and sample 222 was the least rated.

IV. DISCUSSION

➢ *Proximate Composition*

- *Moisture*

A general increase in moisture content was observed as the level of garden egg mash increased in the samples, except for the control sample (100:00), which showed the lowest moisture. Even with the observed increase, samples maintained values below 10.00%, thus can be referred to as low-moisture products. Low moisture content is normally regarded as an advantage for products like biscuits as this supports a longer shelf life due to lower microbial influence [15]. The slight increase in moisture noticed in Sample 60:40 may be due to the increased water retention by dietary fiber in the packed fibrous structure of the fruit [16], although the softening step, which involved cooking during its preparation procedure, led to cellular shrinkage which helped to extract moisture. Low moisture is desirable for the crispness and crunchiness of baked products.

- *Ash*

The ash content of a food sample, which is an indicator of total mineral content, reflected the mineral-rich nature of garden egg, which has been reported to contain notable minerals like calcium, potassium, magnesium, as well as iron in high amounts [17]. Similar results were reported by Odo et al. [18] in vegetable-enriched cookies, where mineral content improved in proportion to the substitution level. This enhancement contributes to the nutritional quality of the biscuits, potentially addressing micronutrient deficiencies in populations relying on staple-based snacks.

- *Crude Fiber*

Crude fiber content recorded in the present study clearly demonstrates the positive contribution of garden egg fruit as a fiber enhancer in food systems. Literature on garden eggs clearly reveals that they inherently possess high levels of fiber, such as cellulose and hemicellulose, which are insoluble in the human gut [19]. Similarly, Fasogbon et al. [20] observed such trends in a study where flours made from okra and leafy vegetables were used to fortify cereal-based snacks. Fiber promotes gastrointestinal health and satiety, as well as helps in the management of cholesterol and blood glucose levels. Thus, it can be said that the products obtained in this study can be termed functional foods, delivering structural benefits beneficial to humans upon consumption.

- *Fat Content*

The reduction in crude fat observed in the formulated wheat-garden egg biscuits may be due to the fact that the fat profile of garden egg is low, thus reducing the overall fat contents of the samples as their inclusion increased. The main source of fat in the sample formulation is from the added margarine and wheat flour. Although these served as standard ingredients, nutritionally, their presence in such food may be undesirable and may often be the reason why some health-conscious consumers normally avoid such foods. According to World Health Organization dietary guidelines, lowering the consumption of saturated fat will reduce the risk of heart-related diseases [21]. Thus, the samples formulated in this study can be recommended to consumers that are looking for nutrient-rich, low-fat pastries.

- *Crude Protein*

For crude protein content, which showed a gradual increase with increasing garden egg incorporation, then a slight drop (13.28%) recorded in Sample 555, this decline may be tied to the fact that the 40% increase in garden egg inclusion might be overwhelming for the protein structure which holds gluten together, thus losing its form. Another reason may be that of protein denaturation during baking. Akinola et al. [22] reported similar results. When legumes were used to enrich cookies at moderate levels, the protein content was enhanced, but at a higher level of inclusion, it was observed that the protein content dropped. This was said to be due to the lower quality proteins found in plant sources, which might not favor too much substitution. Also, the denaturation impact of heat on proteins was implicated.

- *Carbohydrate Content*

The gradual decrease in carbohydrate with a corresponding increase in garden egg inclusion in this study was as expected. Garden egg possesses lower carbohydrate

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content; thus, increasing its level in the biscuits formulation which led to a drop in the macronutrient. While carbohydrate foods are energy providers, its reduction in the formulations will be beneficial in the area of reduced glycemic index of the biscuits, thus may be of interest to overweight, obese, and diabetic persons.

Table 1 Proximate Composition (%) of Wheat-Garden Egg Biscuits

Samples	Moisture	Ash	Crude fibre	Fat	Protein	Carbohydrate
111	$5.00^{c}\pm0.00$	$0.85^{e}\pm0.00$	$0.59^{e}\pm0.01$	$22.37^{a}\pm0.02$	$11.18^{e}\pm0.52$	$60.00^{a}\pm0.06$
222	$5.15^{b}\pm0.02$	$1.67^{d}\pm0.03$	$5.09^{d}\pm0.02$	$21.47^{b}\pm0.06$	$12.30^{d}\pm0.03$	$54.31^{d}\pm0.05$
333	$4.13^{e}\pm0.06$	$1.87^{c}\pm0.06$	$5.60^{c}\pm0.02$	$20.04^{c}\pm0.03$	$12.80^{c}\pm0.05$	$55.54^{b}\pm0.01$
444	$4.26^{d}\pm0.06$	$2.13^{b}\pm0.03$	$5.88^{b}\pm0.01$	$19.23^{d}\pm0.06$	$13.60^{a}\pm0.00$	$54.88^{c}\pm0.02$
555	$5.29^{a}\pm0.23$	$2.25^{a}\pm0.00$	$6.22^{a}\pm0.02$	$18.69^{e}\pm0.01$	$13.28^{b}\pm0.05$	$54.25^{d}\pm0.03$

Values are mean ± S.D (n = 3). Values with the same superscript along same column are not significantly ($p>0.05$) different.

✓ *Key*

- 111 = 100% Wheat flour
- 222 = 90% Wheat flour + 10% Garden egg
- 333 = 80% Wheat flour + 20% Garden egg
- 444 = 70% Wheat flour + 30% Garden egg
- 555 = 60% Wheat flour + 40% Garden egg

➢ *Mineral Composition of Wheat-Garden Egg Biscuits*

- *Sodium (Na)*

As recorded in Table 2, moderate levels of sodium were observed in this study. The values recorded here fall within safe limits recorded by WHO. The safe dietary limit is said to be below 2000mg [23]. This is an advantage because, in moderation, sodium is an essential mineral for the maintenance of body fluid balance and good functioning of the nervous system.

- *Potassium (K)*

The Potassium content recorded in this study implies that samples can help in the balance of hypertensive conditions which could be imparted by sodium in foods as well as offer support to muscular and heart functions. Previous studies conducted by Oboh and Ekperigin [24] indicated a high potassium content in garden egg-based foods. This information is an advantage for the samples, as they are potentially cardio-protective, thus suitable for persons managing and avoiding heart-related conditions.

- *Magnesium (Mg)*

Magnesium levels in the formulated wheat-garden egg biscuits imply that they can serve as a source of the nutrient serving as a cofactor in enzymic reactions. In over 300 enzymatic reactions recorded to take place within the human body, cofactors participate to generate energy and other effects. Similar findings were documented by Ajayi et al. [25], who stated that there was an increase in magnesium content in composite flours combined with vegetable powders. This information presents an advantage about the use of garden eggs as a source of natural magnesium, especially as an ingredient in food formulations that may benefit those who are interested in its nutritional impact on diet-related conditions.

- *Calcium (Ca)*

Increasing calcium content with a corresponding increase in garden egg mash was observed in the current study. This implies that the formulated samples would support bone formation in children, clotting of blood during injury, prevention of osteoporosis in adults, and other related functions of the neurons and muscular system of the human body. These results also imply that food calcium enrichment can be achieved with the utilization of the formulated samples. Research reports by Ejoh et al. [17] presented similar values for calcium in garden eggs.

- *Iron (Fe)*

There was an observed increase in iron in the formulated wheat-garden egg biscuits. Iron is important for oxygenated blood circulation throughout the whole human body. Also, its presence supports anemia prevention and synthesis of hemoglobin. Reports by Fasogbon et al. [20] revealed results similar to those obtained in this study for a cereal-vegetable composite product. Sample 555 particularly showed the highest iron content. This could help to serve as a good iron source for enrichment to prevent iron deficiency in humans, with developing countries needing such help.

- *Phosphorus (P)*

Phosphorus is known to play vital roles in the mineralization of the bones as well as the production of Adenosine triphosphate (ATP) during metabolism [26]. This recorded increase, when considered alongside the high content of calcium, will ensure that the formulated samples support overall skeletal health as well as energy production.

- *Zinc (Zn)*

The mineral composition determined for this present study indicates zinc as the most enhanced mineral in the formulated wheat-garden egg samples. Zinc's functions in the body include immune system support, healing of wounds, as well as enhancing enzyme activities [27]. Zinc has been termed to be deficient in foods consumed by low-income persons; thus, utilizing garden egg in formulations will not only boost but fortify such food, thereby creating nutritional impact [28]. The increase in zinc content in these formulated samples indicates that garden egg can serve as a functional food source for zinc enrichment in food systems.

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Table 2 Mineral Composition of Wheat- Garden Egg Biscuits (mg/100g)

Samples	Na	K	Mg	Ca	Fe	P	Zn
111	30.50^{e}±0.02	180.78^{e}±0.03	60.12^{e}±0.04	161.39^{e}±0.05	10.12^{e}±0.02	63.25^{e}±0.24	2.73^{e}±0.01
222	38.16^{d}±0.04	202.13^{d}±0.06	74.28^{d}±0.07	170.29^{d}±0.07	11.34^{d}±0.08	70.26^{d}±0.03	6.08^{d}±0.01
333	43.09^{c}±0.02	230.77^{c}±0.09	86.33^{c}±0.10	181.33^{c}±0.08	13.13^{c}±0.06	81.09^{c}±0.06	9.36^{c}±0.06
444	50.78^{b}±0.06	248.27^{b}±0.13	104.5^{b}±0.08	190.28^{b}±0.05	16.30^{b}±0.00	90.28^{b}±0.03	11.40^{b}±0.00
555	55.40^{a}±0.00	261.30^{a}±0.00	115.3^{a} ±0.04	201.09^{a}±0.08	19.21^{a}±0.05	107.4^{a}±0.00	13.77^{a}±0.05

Values are mean ± S.D (n = 3). Values with the different superscript along same column are significantly ($p<0.05$) different.

✓ *Key:*

- 111 = 100% Wheat flour
- 222 = 90% Wheat flour + 10% Garden egg
- 333 = 80% Wheat flour + 20% Garden egg
- 444 = 70% Wheat flour + 30% Garden egg
- 555 = 60% Wheat flour + 40% Garden egg

➢ *Sensory Properties of Wheat -Garden Egg Biscuits*

Sensory results as shown in Table 3 indicate that all formulated wheat-garden egg biscuits were scored above average, implying that none was rejected by the taste panel. In terms of appearance, samples 444 (7.95) and 555 (8.35) shared similarity with the control, thus were not significantly different ($p>0.05$). Samples 222 and 333, however, exhibited differences ($p<0.05$). This rating may be due to the introduction of garden egg mash which might have altered and led to a darker color tone. This can be caused by the presence of phenolics like anthocyanins contained in garden egg, which often induce color changes in food products [29]. The appearance attribute often describes the observable color, uniformity in shape and size of a product, and other visually appealing qualities.

In terms of flavor, the inclusion of garden egg mash might have introduced slightly noticeable bitter or astringent compounds, especially for sample 444. For sample 555 with 40% inclusion of garden egg mash, flavor was rated higher. This effect may be due to ingredient interactions that may have balanced the formulation. This type of result is often observed when untrained or semi-trained panelists are used in a study; most of them may be caught in expectation error and their lack of experience could inform their judgment of samples.

The mouth feel of the biscuit samples declined with an increase in garden egg inclusion, though sample 333 still maintained a high score. This may be due to changes or deviations from the wheat biscuits the panel members are conversant with. Another point may be due to the high fiber contained in the garden egg, which might have interfered with the smoothness of the samples observed in higher inclusion levels.

The taste assessment of the formulated samples revealed that, at the lowest inclusion level (10%), garden egg may not have influenced taste but might have interfered with the flavor profile of the formulated biscuits. At higher inclusion levels, however, the change is noticeable as revealed by the test scores. This suggests a threshold effect beyond which flavor compounds inherent in garden egg mash begin to positively influence the taste of the samples [30].

For crispiness, the similarity ($P>0.05$) observed across all samples indicates that garden egg inclusion did not affect the crispiness of the biscuits. This implies that both the baking conditions and the inherent qualities of the garden egg mash did not introduce any perceived changes in the products.

For texture, the similar trend of no significant ($P>0.05$) differences across all samples gives an advantage to the formulated samples. Although the control had the highest rating, all the other samples were statistically similar. This may be due to smooth blending or mixing of garden egg mash with other ingredients which led to good cohesion and crunchiness after baking [31].

The mean scores for overall acceptability of the formulated biscuits revealed that the control sample was most preferred. While this may be expected due to its popularity, it was observed that samples 444 and 555 shared some similarities with the control. Also, the least preference for sample 222 may be due to the fact that since it was the formulation with the least garden egg inclusion, it had the least impact on the sensory qualities of the sample.

Table 3 Sensory Properties of Wheat -Garden Egg Biscuits

Samples	Appearance	Flavour	Mouthfeel	Taste	Crispiness	Texture	Overall acceptability
111	8.50^{a}±0.82	8.40^{a}±0.68	8.50^{a}±0.88	8.70^{a}±0.47	8.15^{a}±1.08	8.30^{a}±0.92	8.70^{a}±0.57
222	7.75^{b}±0.85	7.60^{c}±0.50	7.75^{bc}±0.78	7.50^{c}±0.60	8.10^{a}±0.64	7.85^{a}±0.67	7.85^{b}±0.49
333	7.80^{b}±1.05	7.90^{b}±0.78	8.05^{ab}±0.99	8.15^{b}±0.81	7.80^{a}±0.83	7.75^{a}±0.85	8.15^{b}±0.98
444	7.95^{ab}±0.88	7.30^{d}±0.97	7.40^{d}±0.82	8.10^{b}±0.91	7.60^{a}±0.94	7.75^{a}±0.96	8.25^{ab}±0.78
555	8.35^{ab}±0.87	8.10^{ab}±0.72	7.90^{b}±0.85	7.95^{bc}±1.05	7.65^{a}±0.87	8.15^{a}±0.93	8.35^{ab}±0.74

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