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Journal of Nutrition and Food Processing
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Research Article

Development and Characterization of Biscuit Produce from Wheat, Carrot and Haricot Bean Composite Flour

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Received date: August 14, 2023; **Accepted date:** October 04, 2023; **Published date:** October 12, 2023

Citation: Masresha G. Ewunetu, Sisay W. Molla (2023), Development and Characterization of Biscuit Produce from Wheat, Carrot and Haricot Bean Composite Flour, *J. Nutrition and Food Processing*, 6(8); **DOI:10.31579/2637-8914/125**

Abstract:

In Ethiopia consumption of baked foods is greatly increasing. Moreover, products Protein and vitamin deficiency are still a major concern in the country and it cause disease and death in children under the age of 6 years. A blending of 100:0:0; 90:5:5; 80:10:10; 70:15:15; 60:20:20; 50:25:25 and 40:30:30 percent wheat: carrot: haricot bean flours were used to make composite biscuit. The proximate structure, functional properties, and sensory assessment were evaluated using standard methods. The experiment subjected to one-way analysis of variance (ANOVA) using the statistical analysis system (SAS) software package. The results showed that partially replacing wheat with carrot and haricot bean increased the proximate composition of moisture (5.98-10.55%), protein (10.49-16.55%), ash (1.87-3.06%), fiber (1.36-3.22%), and fat (1.15-2.43%) significantly. Whereas carbohydrate (79.15-64.19%) and energy (368.91-344.83 kcal/g) decreased significantly. Sensory acceptability (appearance, Crispiness, color, flavor, taste, and overall acceptability) was higher in the composite biscuits with up to 30% wheat substitution by carrot and haricot bean than 100% wheat flour biscuits. Based on the findings of this report, using carrot and a haricot bean to wheat flour blend in biscuit formulation appears to be promising in terms of nutritional quality, acceptability, and cost. It is proposed that these products be marketed to vitamin A deficiency (VAD) customers and it have a chance to reduce food insecurity

Key words: carrot; biscuit; malnutrition; haricot bean; wheat

1.Introduction

Nutritional deficiencies, such as, protein malnutrition and vitamin A deficiencies are the major health problem in developing countries and dominantly affect young children. They also cause of illness and death, children's developing countries (Krishnakumar, 2006). Moreover, tendency to depend upon one or more food components that ultimately leads to lower intake of micronutrients and macronutrients has come out owing to industrialization and changing lifestyle. Among protein, Iron, zinc, iodine and vitamin A are the most chronic forms of macro and micronutrient afflictions (Sramkova & Agricultural, 2017). In the world over three billion people are currently malnourished. This global crisis in nutritional health is the result of dysfunctional food systems that do not consistently supply enough of these essential nutrients to meet the nutritional requirements of high-risk groups (Sramkova & Agricultural, 2017).

Animal-based foods are a decent source of protein, but they are costly (Shewry & Hey, 2015). It is important to combating hunger and malnutrition, by producing cookies with high nutrient density, low size, and low-cost, locally available crops. Pulses are a low-cost protein source, particularly for low-income families. Carrot also perishable roots that contain much amount of vitamin A content.

Wheat is an important source of carbohydrates. Globally, it is the leading source of vegetal protein in human food, having a protein content of about 13%, which is relatively high compared to other major cereals, but relatively low in protein quality for supplying essential amino acids (Kim et al., 2019). When eaten as the whole grain, wheat is a source of multiple nutrients and dietary fiber. Glutenin and gliadin are functional proteins found in wheat biscuit that contribute to the structure of biscuit. Wheat contains far from adequate amounts of vitamin A precursors and mineral (Jariyah et al., 2018).

Carrot is a root vegetable, usually orange in color, though purple, black, red, white, and yellow cultivars exist. Carrots are a domesticated form of the wild carrot, Daucus carota, native to Europe and southwestern Asia. Carrot is one of the important root vegetables rich in bioactive compounds like carotenoid and dietary fibers with appreciable levels of several other functional components having significant health-promoting properties. The consumption of carrot and its products is increasing steadily due to its recognition as an important source of natural antioxidants having anticancer activity. Carrot dietary fiber comprises mostly cellulose, with smaller proportions of hemicelluloses, lignin and starch. Free sugars in carrot include sucrose, glucose and fructose (Owusu et al., 2021). Carrots are an excellent source of antioxidant compounds, and the richest vegetable source of the provitamin A.

Pulses have several beneficial characteristics, including high nutritional value, long storage times, and a low cost compared with animal products. They contribute significantly to the provision of protein and micronutrients to developing-world populations. Beans are high in dietary protein, which is important for human nutrition, particularly when combined with other foods. Pulses are grown in various parts of Ethiopia; however, pulse consumption is not widespread in Ethiopia. The use of haricot bean flour in bakery products would open up a whole new market for protein-rich foods. In contrast to wheat alone, a good blend of wheat, carrot, and haricot bean flours will produce nutritionally enriched biscuits. Local raw materials substitution for wheat flour is increasing due to the growing market for confectioneries. Apart from being readily available and cheap, both haricot and carrot are chosen for their high nutrients that are complementary to each other. The aim of this research is therefore to produce nutritionally enriched biscuit from composite flours of wheat, carrot and haricot bean flours and to determine its physicochemical as well as the sensory properties of biscuit.

2. Materials and Methods

2.1. Materials and Sample Collection

The raw materials wheat flour, carrot, haricot bean, salt, sugar, and oil were purchased and transported to Bahir Dar Institute of Technology Food Engineering laboratory. Equipment's such as blender, mixer, kneader, bowl, knife, digital weighing scale, measuring cylinder, boiler, baking pans, and oven were obtained in the Food Processing laboratory of Bahir Dar University. After collection of raw material preparation of raw material for biscuit for production was started. All other chemicals used were of analytical Chemistry laboratory.

2.2. Sample preparation

Preparation of haricot bean flour

The seed was sorted, washed, and soaked in distilled water in a water bath at 25°C for 24 hours at a ratio of 1:10 (w/v). The soaked seeds were washed twice in water, then rinsed with distilled water before being dried in a 60°C oven for 48 hours (Kindeya et al., 2022). The dried bean was dehulled and milled into flour using a laboratory grinder and sieved with a (700 μm) sieve size before being packed in a polyethylene plastic bag for further study and held in a cool, dark place using a desiccator.

Preparation of Carrot Flour

The carrot fruits were washed in portable water, peeled, sliced into 56 mm thickness; the sliced carrots were blanched for 3 minutes in hot water (95 °C) to prevent browning and discoloration. The carrots were immediately cooled by exposing to air and dried in oven drier at 50 °C for 12 hours. The dried fruit was ground to fine powder and sieved with a 700 μm sieve and was packaged in bag for further uses.

2.2. Experimental design

The experiment was design using one-way factorial experiments design with five levels of the blending ratio coded as C, B1, B2, B3, B4, B5 and B6. The blending contains different proportion of wheat, carrot and haricot flour. The composite was created by taking into account some key facts about biscuit characteristics as well as previous research. Soft wheat flour is one of the most essential ingredients in biscuits, as flours that produce biscuits with a larger spread and smoother texture are preferred. Wheat, carrot powder and haricot bean flour were blended by varying percentages (100, 0, 0), (90, 5, 5), (80, 10, 10), (70, 15, 15), (60, 20, 20) (50, 25, 25) and (40, 30, 30) % respectively.

Finally, each experimental was done in triplication. Experimental design and ingredient formulation were listed in **Table 1** and **Table 2** respectively

Sample	Carrot flour (%)	Haricot flour (%)	Wheat flour%
C	0	0	100
B1	5	5	90
B2	10	10	80
B3	15	15	70
B4	20	20	60
B5	25	25	50
B6	30	30	40

Table 1: Formulation of flour blends of wheat, carrot and haricot for biscuit production.

Note: - 100% wheat (C), 90%wheat, 5%carrot, 5%haricot (B1), 80% wheat, 10% carrot, 10% haricot (B2), 70% wheat, 15% carrot, 15% haricot (B3) and 60%wheat, 20%carrot, 20% haricot (B4), 50%wheat, 25%carrot, 25% haricot (B5) and 40%wheat, 30%carrot, 30% haricot

Ingredients	Composition
Baking powder (g)	1.12
Sugar (g)	5
Salt (g)	1
oil (g)	28
Water (ml)	48

Table 2: Ingredient formulation to produce wheat, banana and carrot-based biscuit for 100g four

2.3. Carrot and haricot bean flour enriched biscuits making processes

All of the ingredients were measured in standard measuring scale and mixed. The flours and ingredients involve i.e., hydration & blending, for dough development. The mixed dough was subjected for 20 minutes at room temperature to obtain light aerated porous structure of fermented product. After the dough was prepared, it was manually sheeted to a thickness of 5 mm sheeting. The biscuits were then formed and cut to a diameter of 48 mm before being placed on a lightly greased baking tray. In a baking oven, the biscuits were baked for 12 minutes at a temperature of 200°C. The baking temperature was chosen based on some key evidence, such as the fact that carotene is susceptible to heat degradation and that a temperature of 200°C for a 12-minute exposure period results in better beta carotene retention.

2.4. Chemical analysis

2.4.1 Functional properties of flours

Bulk density

The bulk density of composite flour was determined using the method described by. In a 50-mL measuring cylinder, 10 g of sample flour was placed. The cylinder was tapped repeatedly until the volume remained unchanged. The sample's bulk density (g/mL) was determined by dividing the weight of the sample by the volume of the sample.

$$\text{Bulk density} = \frac{\text{mass of sample}}{\text{volume of sample}}$$

Water absorption capacity (WAC)

According to Aremu et al., 15 the water absorption ability of flour samples was determined. In a centrifuge tube, 1 g of flour sample was mixed with 10 mL of distilled water and allowed to stand at room temperature for 30 minutes. The supernatant was collected in a 10 mL graduated cylinder after centrifugation at 5,000 rpm for 30 minutes. The amount of oil absorbed per gram of flour sample was measured as mL of oil absorbed per gram of flour sample.

Oil absorption capacity (OAC)

According to Aremu et al., 15 the oil absorption ability of flour samples was determined. In a centrifuge tube, 1 g of flour sample was mixed with 10 mL of oil and allowed to sit at room temperature for 30 minutes. It was centrifuged for 30 minutes at 5,000 rpm, with the supernatant collected in a 10 mL graduated cylinder. The amount of oil absorbed per gram of flour sample was measured as mL of oil absorbed per gram of flour sample.

2.4.2. Proximate chemical analysis for biscuit

Proximate analysis was carried out on the biscuit and flour to determine the moisture, ash, crude fiber, fat, protein and carbohydrate content.

Moisture content

The moisture content was determined by hot air oven method as described by (AOAC, 2005). A 2g of sample was transferred into the weighed crucible. This was taken into the hot air oven and dried for 24 hours at 103 °C. The crucible and its contents were cooled in the desiccators and their weights taken. Finally, the percentage moisture content is calculated as follows:

$$\%\text{Moisture content} = \frac{W1-W2}{W1-W}x100$$

Note: - Mass of dish (W), mass of dish + sample before drying (W1) and mass of dish + sample after dry (W2)

Ash content

Ash content was determined using the method of (AOAC, 2005). About 5 g of each sample was weighed into crucibles, and then the sample was incinerated in a muffle furnace at 550 °C until a light grey ash was observed and a constant weight obtained. The sample was cooled in the desiccators to avoid absorption of moisture and weighed to obtain ash content. Finally, the percentage of ash is calculated as follows.

$$\%\text{ Ash}= \frac{W2-W}{W1-W}x100$$

Note: - Weight of empty crucible (w), Weight of crucible with sample (w1), Weight of crucible with sample after drying (w2).

Crude protein determination

The micro Kjeldahl method as described by (AOAC, 2005) was used to determine crude protein. A 2g of sample was added into the digestion flask. One gram of copper sulphate and sodium sulphate (catalyst) in the ratio 1:10 respectively and 5 ml concentrated sulphuric acid were also added to the digestion flask. The flask was positioned into the digestion block in the fume cupboard and heated until frothing ceased giving clear and light blue green coloration. The mixture was then allowed to cool and diluted with 30ml distilled water and followed by 30ml of 40%NaoH was added. Distillation apparatus was connected. The released ammonia by boric acid was then treated with 0.01 m of hydrochloric acid until the green color change to purple. Percentage of nitrogen in the sample was calculated using the formula below:

$$\%\text{Nitrogen (N)} = \frac{VHClxNHClx14}{Sample\ weight}x100$$

Note: - Volume of HCl consumed to the end point of titration (V), Normality of HCl used often is about 0.01N (N), and molecular weight of nitrogen (14)

Conversion of nitrogen percentage in to % protein % Protein = F * %N. where, F is the conversion factor in most case is 6.25

Crude fat

Soxhlet extraction method described by (AOAC, 2005) was used in determining fat content of the samples. About 2g of the sample was weighed and the weight of the flat bottom flask taken with the extractor mounted on it. The thimble was held far way into the extractor and the weighed sample. Extraction was carried out using (boiling point 40-60 °C. The thimble was plugged with cotton wool. At completion of extraction which lasted for 3 hours, the solvent was removed by evaporation on an oven and the remaining part in the flask was dried at 70 °C The fat was dried in oven for 30 minutes and then cooled in desiccators. The mass of flask was reweighed and percentage fat calculated as:

$$\%\text{Fat content} = \frac{weight\ of\ fat}{weight\ of\ sample}x100$$

Determination of Crude Fiber

Crude fiber was determined using the method of (AOAC, 2005). A 5g of sample was weighed into a 500 ml Erlenmeyer flask and 100 ml of TCA digestion reagent was added. It was boiled and refluxed for 40 minutes starting boiling. The flask was removed from the heater, cooled a little then filtered through a 15.0 cm number 4 Whitman paper. The residue was washed with hot water and transferred to a porcelain dish. The sample was dried at 105 °C. overnight. After drying completed, it was transferred to a desiccator and weighed as W1. It was then burnt in a muffle furnace at 500°C for 6 hours, allowed to cool, and reweighed as W2.

$$\%\ \text{Crud fiber} = \frac{W1-W2}{weight\ of\ sample}x100$$

Note: - Crucible weight after drying (W1), Crucible weight after ash (W2)

Carbohydrate analysis by Difference

% CHO = 100 – (% moisture + % ash + % protein + % fat+%crude fiber)

Determination of total caloric value

Caloric value = 4*CHO+4*protein+9*fat

Determination of β-Carotene Content

As shown Figure 2, β -carotene was determined using the method of (Bibiana et al., 2014). A 5g of biscuit crumbs were weighed into a separatory funnel (250 ml), 2 ml of NaCl solution was added and shaken vigorously, followed by the addition of 10 ml of ethanol, then 20 ml of hexane. The mixture was shaken vigorously for 5 minutes and allowed to stand for 30 minutes after which the lower layer was run off. The absorbance of the top layer was determined at a wavelength of 460 nm using spectrophotometer.

$$\text{Total carotenoid μg/100g} = \frac{Absorbance}{specific\ extiction\ coefficient*path\ length\ of\ cell}$$

Not: - Molar extinction coefficient (∑) (15× 10-4), Specific extinction efficient (∑ × molar mass of beta-carotene), Molar mass of β- carotene (536.88 g/mol), and Path length of cell (1 cm)

2.4.3. Sensory acceptability

Panelists measured the sensory acceptability of biscuits based on their willingness to engage in the study. Consumer panelists were chosen randomly from Bahi Dar institute of technology students and instructors to test sensory characteristics of the products, such as appearance, taste, scent, crispiness, color, flavor, and overall acceptability. It was conducted using five-point hedonic scales (1 = dislike very much, 2 = dislike, 3 = neither like nor dislike, 4 = like, and 5 = like very much).

2.5. Statistical data analysis

All analysis was subjected to ANOVA (analysis of variance) to obtain the significance difference between the mean value using Last Significance Difference, LSD ($p<0.05$). The statistical analysis was done by using SAS version 9 software.

3. Results and Discussion

3.1. Functional properties of wheat, carrot and haricot bean flours

The bulk density, water absorption ability, and oil absorption capacity of wheat, carrot and haricot bean flours are shown in **Table 3**. The bulk density of carrot flour was slightly higher than wheat and haricot bean flour. The bulk density of carrot powder is higher than wheat and haricot bean flour. The bulk density of haricot bean flour (0.84) is higher than that of wheat flour (0.76) g/ml almost similar to the study (Kindeya et al., 2022). The high bulk density of flour suggests that it is suitable for use in food preparations; however, the low bulk density of complementary foods would be advantageous. Both haricot bean flour and carrot powder have a higher bulk density than wheat flour, so adding haricot bean and carrot to the composite flour would increase the bulk density of the composite flour as compared to wheat flour. The manufacture of confectioneries such as cakes, sweet pastries, doughnuts, and cookies benefits from an increase in flour bulk density. This means that the flour's heaviness and suitability for confectionery production are both positive. A rise in bulk density improves packaging performance. As a result, a larger amount may be packed into a smaller volume.

Wheat, carrot and haricot bean flours have different water absorption capacity. Wheat flour (14.33%), had lowest water absorption potential while haricot bean flour (22.54%), had the highest water absorption capacity. Both are lower than (16.2 and 23.9) study by Kindeya et al., (2022). The hydrophilic elements, such as carbohydrates and proteins (polar amino acid residues), have a strong affinity for water and contribute to the high WAC value. Water absorption is reduced in flours with a lower proportion of polar amino acids and a higher proportion of nonpolar amino acids. As a result, the observed differences in different flours may be due to differences in protein concentration, water interaction, and conformational characteristics. Both haricot bean flour and carrot powder have a higher WAC than wheat flour, so adding haricot bean and carrot to the composite flour would improve the WAC of the composite flour compared with wheat flour. Increased water absorption weakens the dough and causes it to lose its development and stability. The ability to absorb water is essential in product consistency and bulking, as well as in baking applications. The higher water absorption capacities may have contributed to the lower spread ratio.

The three flours have different water absorption capacity, and oil absorption capacity. Wheat flour had the highest while carrot flour had the lowest oil absorption capacity. Wheat flour has a higher oil absorption ability than carrot powder and haricot bean flour, owing to the lipophilic quality of its constituents. Protein conformation, amino acid composition, and surface polarity or hydrophobicity all play a role in lipophilicity. Wheat flour has a higher OAC than carrot powder and haricot bean flour, so adding haricot bean and carrot powder to the composite flour would lower the OAC compared to wheat flour. When the OAC of composite flour is reduced, the taste and mouthfeel of the cookies suffer. Because of the flour's higher oil absorption potential, it's perfect for enhancing flavor and mouthfeel when used in food preparation.

Flour sample	BD (g/mL)	WAC (%)	OAC (%)
W	0.76 ± 0.05^{b}	14.33 ± 0.25^{c}	24.04 ± 0.22^{a}
HB	0.84 ± 0.10^{b}	22.54 ± 0.68^{a}	19.66 ± 0.84^{b}
Ct	1.13 ± 0.04^{a}	18.31 ± 0.13^{b}	15.70 ± 0.41^{c}

Table 3: Functional properties, wheat, carrot and haricot bean flours.

Mean values not followed with the same letter in a column are significantly different at P< 0.05

Note: Bulk density (BD), Water absorption capacity (WAC), Oil absorption capacity (OAC), wheat flour(W), Haricot bean flour (HB), and carrot flour (Ct).

3.2 Proximate composition of wheat, carrot and haricot bean flours

The proximate composition of carrot powder, wheat, and haricot bean flours (moisture, ash, crude protein, crude fat, crude fiber, carbohydrate, and energy) are shows in **Table 4**. Moisture, protein, ash, fiber, and carbohydrate content were found to be substantially different between the three flours. Haricot bean flour has a slightly higher fat content than wheat flour and carrot powder. Wheat flour had the highest moisture content, while carrot powder had the lowest. Haricot bean flour had the most protein, ash, and fat, while carrot powder had the least protein and wheat flour had the least ash, and fiber. The highest carbohydrate content was contained in carrot powder, followed by wheat flour. Furthermore, the energy content of carrot powder was substantially higher than that of haricot bean flour. In terms of protein, ash, and fat content, haricot bean flour appears to have an advantage over wheat flour. The addition of carrot powder appears to improve the fiber content as well. This because of root plants are the source of fiber.

Flour	Moisture (%)	Crude Protein (%)	Crude Ash (%)	Crude Fiber (%)	Crude Fat (%)	CHO (%)	Energy (kcal/g)
W	11.23 ± 0.11^{a}	11.07 ± 0.71^{b}	1.83 ± 0.77^{c}	1.21 ± 0.03^{c}	1.34 ± 0.11^{b}	$73.32 \pm .00^{b}$	337.56 ± 1.64^{ab}
HB	9.01 ± 0.44^{b}	15.53 ± 0.88^{a}	3.53 ± 0.08^{a}	5.10 ± 0.31^{a}	2.57 ± 0.13^{a}	64.26 2.38^{c}	342.29 ± 7.27^{b}
Ct	3.55 ± 0.81^{c}	5.75 ± 0.79^{c}	2.77 ± 0.80^{b}	5.44 ± 0.20^{b}	1.21 ± 0.01^{b}	81.28 ± 0.34^{a}	359.10 ± 1.42^{a}

Table 4: Proximate composition of wheat, carrot and haricot bean flours

Mean values not followed with the same letter in a column are significantly different at P< 0.05

Note: Wheat flour(W), Haricot bean flour (HB), and carrot flour (Ct).

3.3. Effect of blending ratio of composite flour on proximate composition of biscuits

In Table 5, the approximate compositions of biscuits (moisture, ash, crude protein, crude fat, crude fiber, carbohydrate, and energy) described. The moisture, protein, ash, fiber, and fat content of the biscuit increased as the percentage of haricot bean flour and carrot powder increased. However, when compared with the other proximate elements, carbohydrate content, and energy value showed the opposite trend. As the proportion of wheat flour was reduced and the proportion of haricot bean and carrot powder was increased, both carbohydrate content and energy value decreased 79.15-64.19% and 368.91-344.83 kcal/g respectively. This is supported by wheat, orange fleshed sweet potato and haricot bean flour biscuit studied by Kindeya et al., (2022). Since carrot powder and haricot bean flour have a higher water absorption ability and fiber content than wheat flour, the increase in moisture content in this study may be due to increasing the percentage of carrot powder and haricot bean flour to wheat flour. The latter two flours have higher fiber and water absorption ability than wheat flour.

The hydroxyl group present in the fiber structure allows higher total fiber in non-wheat flour to interact reasonably well with a large amount of water. Since haricot bean flour has higher protein content than wheat flour, the rise in protein content in this study may be due to switching from haricot bean flour to wheat flour. Since haricot bean flour and carrot powder have higher ash content than wheat flour, the increase in ash content of biscuits in this study may be due to increasing the percentage of haricot bean flour and high dry matter content of carrot powder to wheat flour. Increasing the amount of ash content in biscuit made from wheat, haricot bean and carrot powder composite flours by increasing the percentage haricot bean and carrot powder. Since carrot powder and haricot bean flour have higher fiber content than wheat flour, the fiber content increases from (1.36-3.22%) in this study may be due to increasing the percentage of carrot powder and haricot bean flour from (0-30%) and decreasing of wheat flour from (100-40%) in the blended biscuit. Increased fiber content can help with waste passage by expanding the inside walls of the colon, making anti-constipation more efficient, lowering cholesterol levels in the blood, and lowering the risk of various cancers. Since haricot bean flour has a higher fat content than wheat flour, the rise in crude fat content in this study may be attributed to increasing the ratio of haricot bean flour to wheat flour.

The decrease in carbohydrate content of the biscuit may be due to a rise in moisture, fat, ash, and fiber content as the proportion of carrot powder and haricot bean flour in the formulation was increased, resulting in a decrease in carbohydrate content because carbohydrate is measured by difference. The energy content of the biscuit follows the pattern of the carbohydrate content, as carbohydrate is the primary source of energy throughout the biscuit.

Blends	Moisture (%)	Crude Protein (%)	Crude Ash (%)	Crude Fiber (%)	Crude Fat (%)	CHO (%)	Energy (kcal/g)
C	5.98± 0.04^{e}	10.49± 0.44^{e}	1.87± 0.33^{d}	1.36± 0.13^{e}	1.15± 0.09^{e}	79.15± 0.56^{a}	368.91± 1.34^{a}
B1	6.65± 0.13^{e}	11.20± 0.55^{e}	2.00± 0.06^{d}	1.57± 0.08^{de}	1.24± 0.13^{e}	77.34± 0.21^{a}	365.32± 4.13^{a}
B2	7.35± 0.07^{de}	12.11± 0.34^{de}	2.28± 0.77^{c}	1.86± 0.43^{cd}	1.56± 0.64^{de}	75.51± 0.86^{ab}	364.54± 5.55^{ab}
B3	7.78± 0.14^{cd}	13.09± 0.88^{cd}	2.45± 0.01^{b}	2.28± 0.82^{c}	1.80± 0.05^{cd}	72.60± 0.22^{bc}	358.96± 6.18^{ab}

Table 5: Effect of blending ratios on biscuits proximate composition on a wet weight basis (%).

Mean values not followed with the same letter in a column are significantly different at P< 0.05

Note: - 100% wheat (C), 90%wheat, 5%carrot, 5%haricot (B1), 80% wheat, 10% carrot, 10% haricot (B2), 70% wheat, 15% carrot, 15% haricot (B3) and 60%wheat, 20%carrot, 20% haricot (B4), 50%wheat, 25%carrot, 25% haricot (B5) and 40%wheat, 30%carrot, 30% haricot

3.4. Effect of blending ratio of composite flour on sensory acceptability of biscuits

The sensory acceptability of biscuits (color, appearance, flavor, taste, crispiness, and overall acceptability) can be demonstrated in **Table 6**. The one with the highest haricot bean flour and carrot powder (Wheat 40%, Haricot bean 30%, carrot 30%), the appearance of the composite flour biscuits have displayed a substantial difference ($p < 0.05$) compared with 100% wheat flour biscuits (control). The color of all the composite biscuits did not vary significantly from the control ($p < 0.05$). The crispiness of composite flour biscuits containing 20, 25, and 30% haricot bean flour and carrot powder was slightly lower ($p < 0.05$) than that of biscuits made entirely of wheat. In comparison with 100% wheat flour biscuits, the appearance, color, flavor, taste, and overall acceptability scores of the biscuits improved with the addition of haricot bean flour and carrot powder up to haricot bean 20%, carrot 20%. The crispiness of the biscuits, on the other hand, decreased as haricot bean flour and carrot powder was added. The decrease in biscuit crispiness as the proportion of haricot bean flour and carrot powder is increased may be attributed to the increased moisture content of the biscuits as the proportion of haricot bean flour and carrot powder is increased. Except for crispiness, the overall acceptability of the biscuits improved as the haricot bean flour and carrot powder content increased.

The most critical quality attributes that can affect the acceptability of a food product and a consumer's buying decision are its appearance and color. The current study's appearance biscuits made from composite flours containing 70% wheat flour and 15% carrot powder had a higher appearance scores. The attractive color of carrot may have contributed to the composite flour biscuits' increased color acceptability. The addition of haricot bean flour and carrot powder increased the color, taste, acceptability score of the biscuit, which may be attributed to the sweetness of the carrot powder.

Blends	Appearance	Flavor	Color	Crispiness	Taste	Overall Acceptability
C	4.01±0.01^{ab}	4.21±0.34^{a}	3.76±0.02^{b}	4.55±0.07^{a}	4.11±0.08^{b}	3.99±0.02^{ab}
B1	4.22±0.20^{a}	4.26±0.00^{a}	3.82±0.00^{b}	4.43±0.02^{a}	4.25±0.37^{b}	4.10±0.00^{ab}
B2	4.35±0.11^{a}	4.35±0.03^{a}	4.12±0.22^{a}	4.30±0.13^{ab}	4.47±0.65^{a}	4.33±0.05^{b}
B3	4.40±0.24^{a}	4.48±0.05^{a}	4.37±0.21^{a}	4.13±0.71^{ab}	4.60±0.10^{a}	4.50±0.54^{a}
B4	3.99±0.04^{c}	3.94±0.40^{a}	3.66±0.00^{ab}	3.98±0.54^{c}	3.89±0.13^{ab}	3.91±0.39^{c}
B5	3.54±0.33^{c}	3.67±0.01^{b}	3.57±0.18^{ab}	3.74±0.00^{bc}	3.67±0.41^{ab}	3.73±0.26^{c}
B6	3.53±0.34^{c}	3.65±0.02^{b}	3.54±0.14^{ab}	3.71±0.00^{bc}	3.63±0.34^{ab}	3.72±0.66^{c}

Table 6: Effect of blending ratio of composite flour on sensory acceptability of biscuits

Mean values not followed with the same letter in a column are significantly different at P< 0.05

Note: - 100% wheat (C), 90%wheat, 5%carrot, 5%haricot (B1), 80% wheat, 10% carrot, 10% haricot (B2), 70% wheat, 15% carrot, 15% haricot (B3) and 60%wheat, 20%carrot, 20% haricot (B4), 50%wheat, 25%carrot, 25% haricot (B5) and 40%wheat, 30%carrot, 30% haricot (B6)

Conclusion

Biscuits with greater sensory acceptability than wheat-based biscuits can be made by substituting haricot bean flour and carrot powder for up to 40% of the wheat in the recipe (20% haricot bean and 20% carrot powder). Biscuits made with haricot bean flour and carrot powder are more nutritious than wheat-based biscuit in terms of proximate composition (high in protein, fiber, and ash. Based on the findings of this report, using carrot and a haricot bean to wheat flour blend in biscuit formulations appears to be promising in terms of nutritional quality, acceptability, and cost. Development of nutritious and more sensory appealing biscuits by replacing wheat with locally available and inexpensive ingredients (haricot bean and carrot) will benefit high-yielding native plant species, provide a better supply of the nutrient-rich commodity, and improve the overall use of domestic agriculture production.

Acknowledgment

The authors would like to acknowledge laboratory technicians of BiT staffs and Arba Minch university, Sawla campus academicians for support in the time of this research work.

Declaration

We declare that this work is original research article and were not published before. It is not under consideration for publication elsewhere in English or in any other language.

Conflict of Interest

The authors declare that there is no conflict of interest regarding this work.

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DOI: 10.31579/2637-8914/125