FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 6 No. 1, March, 2022, pp 1 - 6
DOI: https://doi.org/10.33003/fjs-2022-0601-862

PROXIMATE COMPOSITION, SENSORY EVALUATION AND PRODUCTION OF COOKIES (BISCUIT) FROM FINGER MILLET AND WHEAT FLOUR

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ABSTRACT
Finger millet (Eleusinecoracana), is an important staple food because of its excellent storage properties, and nutritive value, resistance to disease and tolerance to soil moisture stress. The aim of this study is to determine the nutritional composition of cookies (Biscuit) produced from combination of finger millet and wheat flour and its sensory properties. Biscuit was produced from the formulated ratios (W:F 100, FM:100, W:F 95:5, W:F 90:10 and W:F 80:20) of wheat and finger millet respectively. Proximate composition and sensory evaluation were carried out using standard methods. The results of proximate composition for ration W:F 95:5 shows significant different compare to other ratios and individual flours, additionally the same product shows highly acceptable by the respondent for its taste, flavor and texture than cookies of other composition. Therefore it can be concluded that the product from formulated ratio WF: FM 95%:5% was best cookies highly acceptable. However consumption of such products are highly encouraged and less course effective.

Keywords: Cookies, Finger millet, Proximate, Wheat Flour

INTRODUCTION

Finger millet (FM) is a cereal grain that belongs to the family Poaceaeand is a gluten-free grain (Gebre, 2019). FM is ranked 4th among other millets in the world in importance after sorghum (Sorghum bicolor), pearl millet (Pennisetumglaucum) and foxtail millet (Setariaitalica) (Ramashia et al., 2021). It is cultivated in some parts of African countries such as Ethiopia, Zimbabwe, and South Asian country (Opole, 2019). FM is referred to as mufhoho (Tshivenda) in South Africa (Ramashiaet al., 2019) and dagussain Ethiopia (Kumar et al., 2016). FM consists of different varieties: black, reddish-brown, and white (Gebre, 2019). It contains nutritional elements which are easy to digest thus a major source of food for pregnant women, the sick, lactating mothers, children and diabetics (Tracylineet al., 2021). It is a rich source of calcium which strengthens bones, and teeth. FM has potential health benefits in all age groups and people with chronic diseases (Ramashiaet al., 2019). The grains contain zinc (Zn), amino acids, and vitamin B complex. Usually cultivated in a wide range of soils and climates and because of their short growing seasons, they are of specific importance in semiarid regions. Convenient foods are commercially prepared processed foods, which are designed for the ease of preparation and consumption. Utilization of millets is restricted due to non-availability of processed foods in ready to eat form. Millets can be effectively utilized for developing value added products which can improve the overall diet quality. Millets are small seeded cereals known as nutria cereals which represent rich sources of Phytochemicals and Micronutrients.

Finger millet grains also contain high amount of magnesium and phosphorus. Absorption and utilization of these nutrients in the human body contributes to the reduction of chronic diseases such as lowering of high blood pressure, ischemic strokes, cardiovascular diseases, cancers, obesity and type II diabetes (Ramashia et al., 2018). According to Krishnan et al. (2012) it was reported that finger millet grains contain polyphenols and phytates which are known to influence the availability of minerals. Processing of finger millet grains comprises both traditional and modern methods. The traditional method of processing can be employed in the manufacture of value-added products such as soaked, cooked, malted, papad, fermented, popped or puffed, extruded and multi-grain flour (Sood et al., 2017). Finger millet in terms of nutritional composition ranks higher than other cereal grains, though the grain is extremely neglected and widely underutilized (MOAD 2017).

Nutritional configuration of finger millets contributes to reduced risk of diabetes mellitus, high blood pressure and gastro-intestinal tract disorder when absorbed in the body. Utilization of the grain therefore involves traditional and other processing methods such as soaking, malting, cooking, fermentation, popping and radiation. These processes are utilized to improve the dietetic and sensory properties of finger millet and equally assist in the reduction of anti-nutritional and inhibitory activities of phenols, phytic acids and tannins (Hassan et al., 2021). However, with little research and innovation on finger millet as compared to conventional cereals, there is the need for further studies on processing methods, nutritional composition, health benefits and valorization with a view to commercialization of Finger millet grains. Therefore this study is aimed to determine the nutritional composition of finger millet and it sensory properties by production of cookies (Biscuit) from finger millet and wheat flour.

MATERIAL AND METHODS

Sample Collection

Finger millet samples, wheat flour and other materials used were purchased from Sabon Gari market Kano-Nigeria.

Sample preparation

The samples were prepared by mixing the wheat and Finger millet flour as presented in table 1 below.

Table 1: Proportion of finger millet and wheat flour

SAMPLES	COMPONENTS	BLENDING RATIO (%)
W	Wheat flour	100
F	Finger millet flour	100
W:F	Wheat:Finger millet	95:5
W:F	Wheat:Finger millet	90:10
W:F	Wheat:Finger millet	80:20

Processing of Finger millet flour

The finger millet flour was produced according to the method of Ndife *et al.,* (2011). Briefly; the sorghum grains were sorted and cleaned to remove extraneous materials and then weighed. This was followed by washing of the grains and soaking in water for six hour to remove particles. After soaking, the grains were sun dried and thereafter milled and allowed to pass through 60 µm mesh size to obtain fine flour.

Preparation of Finger Millet Cookies (Biscuit)

Finger millet cookies (Biscuit) was made by adding sugar and butter in a bowl and kneading is done to make it into smooth and fine paste. Generally kneading and mixing is done in blender equipment or manually. Then finger millet flour and wheat flour as described in Table 1 and blend ratio was taken in a bowl and added to blender for blending and kneading purpose. After blending, baking powder was added along with initial blended butter and sugar paste. After fine mixing of the composition it was again added with cardamom for flavor and aroma purpose. The flour blend with water or milk and made into shape in the form of dough. Then dough was made into thin flattened sheets by spreading. The flattened dough was cut into required shapes like star, round and other shapes with help of mold. The mold shaped dough were arranged on tray and kept in micro oven at 120°C for 20 min for baking purpose. After baking, it was cooled and packed. The sequential steps involved in the preparation of cookies are given below.

Moisture Content

Moisture content was determined according to the method described by AOAC, (2004).

Fat Content

Fat content was determined according to the method described by AOAC, (2004).

Protein Content

Protein content was determined according to the method described by AOAC, (2004).

Crude Fiber Content

Crude fiber content was determined according to the method described by (AOAC, 2004).

Carbohydrate content of the flours was determined using the difference formula described by (Hadimani *et al.,* 1993).

The Energy Value

The energy value of all samples was calculated as reported by MAFF, (1981).

The Sensory Evaluation

Sensory evaluation was carried out using a 5-point hedonic scale. 10 semi trained panelist from the department of biochemistry, Bayero University Kano, were used. The 5-point hedonic scale ranged from like a lot (5) to dislike a lot (1). The sample was presented in identical coded containers. Each sample evaluated for Appearance, Aroma, Taste, and Texture. Samples were rated alongside the control sample (100% wheat flour Biscuit).

STATISTICAL ANALYSIS

The results obtained were analyzed using one way Analysis of Variance (ANOVA). Mean were separated using multiple range Test. Significance difference accepted at $P<0.05$ using statistical product for service solution (SPSS) version 20.

RESULTS AND DISCUSSION

The Proximate analysis of both the Finger millet and wheat flour were obtained and presented in Table 1. However, the Proximate analysis of cookies (biscuit) produced from finger millet and wheat flour were also presented in Table 2. The moisture content for samples in this study W:F 100 (10.53 ± 1.45^{a}), FM 100 (14.13 ± 0.60^{b}), W:F 95:5 (8.88 ± 1.07^{a}), W:F 90:10 (10.17 ± 1.16^{a}) and W:F 80:20 (10.31 ± 1.74^{a}) obtained is higher when compared to values for produced Finger millet and wheat flour biscuit W:F 100 (3.53 ± 0.35^{a}), FM 100 (4.65 ± 0.05^{b}), W:F 95:5 (3.27 ± 0.06^{a}), W:F 90:10 (3.44 ± 0.10^{a}) and W:F 80:20 (3.67 ± 0.40^{a}) however, this value is higher than those for some plant foods, rare cowpea (1.8%), cranberry bean (1.7%), Kersting's groundnut (1.7%) (Aremu*et al*, 2006b). But in close agreement with those reported for *Luffacylindrica* (5.8%), fluted pumpkin seeds (5.02%) (Olaofe *et al*., 1994). The low moisture content indicates a long shelf life for the cereal flour.

The crude fat W:F 100 (2.52 ± 1.00^{a}), FM 100 (1.43 ± 0.21^{a}), W:F 95:5 (1.87 ± 0.33^{a}), W:F 90:10 (1.45 ± 0.25^{a}) and W:F 80:20 (1.37 ± 0.33^{a}) lower compared to values for produced Finger millet and wheat flour biscuit W:F 100 (7.81 ± 0.10^{a}), FM 100 (7.08 ± 0.13^{b}), W:F 95:5 (7.09 ± 0.12^{b}), W:F 90:10 (6.97 ± 0.12^{b}) and W:F 80:20 (7.07 ± 0.29^{b}) is higher when compared with the reported values for bambara groundnut (4.15%) (Adeyeye and Adamu, 2005). However, the result indicated that *Eleusinecoracana* cannot be grouped under oil rich plant foods (Aremu*et al*, 2006b).

The ash content W:F 100 (1.47 ± 0.31^{a}), FM 100 (2.83 ± 0.25^{b}), W:F 95:5 (2.20 ± 0.61^{ab}), W:F 90:10 (2.32 ± 0.69^{ab}) and W:F 80:20 (2.83 ± 0.25^{b})-(2.51 ± 0.11) is lower compared to values for produced Finger millet and wheat flour biscuit W:F 100 (3.68 ± 0.10^{a}), FM 100 (4.70 ± 0.21^{b}), W:F 95:5 (4.02 ± 0.03^{a}), W:F 90:10 (4.40 ± 0.17^{c}) and W:F 80:20 (5.04 ± 0.05^{b}). It is however, slightly lower when compared with the reported values for varieties of some Nigerian underutilized legume flours such as Bambara groundnut (4.30 ± 0.13) Kersting's groundnut (3.20 ± 0.05) and cowpea (3.60 ± 0.02). This suggests that the finger millet flour could probably provide essential, valuable and useful minerals needed for good body development.

The crude protein content is W:F 100 (10.75 ± 0.78^{a}), FM 100 (7.97 ± 0.67^{b}), W:F 95:5 (10.52 ± 1.30^{ab}), W:F 90:10 (9.64 ± 1.22^{ab}) and W:F 80:20 (9.59 ± 1.03^{ab}) lower when compared to values for produced Finger millet and wheat flour biscuit W:F 100 (16.09 ± 0.09^{a}), FM 100 (17.52 ± 0.45^{b}), W:F 95:5 (17.23 ± 0.15^{b}), W:F 90:10 (16.54 ± 0.05^{a}) and W:F 80:20 (15.30 ± 0.17^{c}) is lower when compared with those of protein rich foods such as soyabean, cowpeas, Kersting's groundnut, pigeon peas, Bambara groundnut (Aremu *et al*., 2006b) and some soil seeds. Finger millet could therefore be used as an alternative source of protein in diets/protein supplement especially in nations like Nigeria where the majority of the populace live on starchy food and cereals.

The crude fibre W:F 100 (1.77 ± 0.80^{b}), FM 100 (4.09 ± 0.37^{a}), W:F 95:5 (1.89 ± 0.34^{b}), W:F 90:10 (2.00 ± 0.06^{b}) and W:F 80:20 (2.10 ± 0.19^{b}) lower compared to values for produced Finger millet and wheat flour biscuit W:F 100 (3.91 ± 0.11^{a}), FM 100 (5.52 ± 0.02^{b}), W:F 95:5 (3.28 ± 0.13^{c}), W:F 90:10 (3.51 ± 0.11^{cd}) and W:F 80:20 (3.80 ± 0.20^{ad}) is in close agreement with the values reported for *Luffacylindrica* (2.5 ± 0.40) (Fagbemi and Oshodi, 1991), cowpea (2.4%) and gourd seed (2.8%) (Akintayo *et al*., 2002), but lower than that reported for soya bean (4.28%).

This suggests that finger millet could provide additional dietary fibre in the diet.

The Carbohydrate content of W:F 100 (72.97 ± 1.46[a]), FM 100 (72.97 ± 1.46[a]), W:F 95:5 (74.44 ± 1.32[a]), W:F 90:10 (74.42 ± 3.23[a]) and W:F 80:20 (73.81 ± 3.34[a]) compared to values for produced Finger millet and wheat flour biscuit W:F 100 (62.63 ± 0.07[a]), FM 100 (60.60 ± 0.17[b]), W:F 95:5 (66.44 ± 0.11[c]), W:F 90:10 (65.52 ± 0.25[d]) and W:F 80:20 (65.07 ± 0.06[c]) - (73.32 ± 0.23 kg/100g) is significantly higher than reported values for *Luffacylindrica*seeds (13.6%), *GandermaSpp*(0.3 ± 2.0), *Omphalotus*(50.6 ± 1.0) (Gyar and Ogbonna, 2006).

The Energy content of this study is presented W:F 100 (357.52 ± 3.04[a]), FM 100 (352.95 ± 4.62[b]), W:F 95:5 (356.63 ± 5.23[a]), W:F 90:10 (349.32 ± 6.80[a]) and W:F 80:20 (345.89 ± 6.85[a]) slightly lower when compared to values for produced Finger millet and wheat flour biscuit W:F 100 (395.19 ± 0.61[a]), FM 100 (374.17 ± 1.95[b]), W:F 95:5 (394.53 ± 1.29[a]), W:F 90:10 (385.34 ± 0.14[c]) and W:F 80:20 (381.23 ± 0..64[d]). This indicates that, it could serve as a good source of energy.

The sensory evaluations of both the biscuit produced from finger millet and wheat flour were carried out, where Aroma, Taste, Appearance and Texture of both the two products were presented in Figure 1, 2, 3 and 4 respectively. A panel of semi-trained judges consisting of 10 members were given the extruded snack food samples for evaluation of organoleptic characteristics viz. appearance, colour, taste, texture. The average score recorded by judges was considered, presented, and discussed. The mean scores of sensory evaluation showed that all the extruded products prepared from composite flours were within the acceptable range, while the extruded product prepared from composite flour sample; W:F 100: , FM 100: , W:F 95:5 , W:F 90:10 , WF 80:20. The study shows that Sample W:F100 has significantly better appearance, aroma, taste and texture. It was revealed from the scores of the overall acceptability that millet mixed with grains can be successfully used to produce a better acceptable product.

This study shows sensory properties of biscuit produced from finger millet and wheat flour (WF100%, FM100%, W:F 95%/5%, W:F 90%/10% and W:F 80%/20%) composition are represented in the chart. The chart with the same letters (superscript) are not significantly different, and chart with different letters (superscript) are significantly different.

The bar chart shows the complete wheat flour WF100% and W: F 95%/5% has the highest ratio of acceptability, while finger millet FM100% has the highest ratio of unacceptability. Base on their appearance, aroma, taste, and texture.

Table 1: Proximate Composition of Finger Millet and Wheat Flours

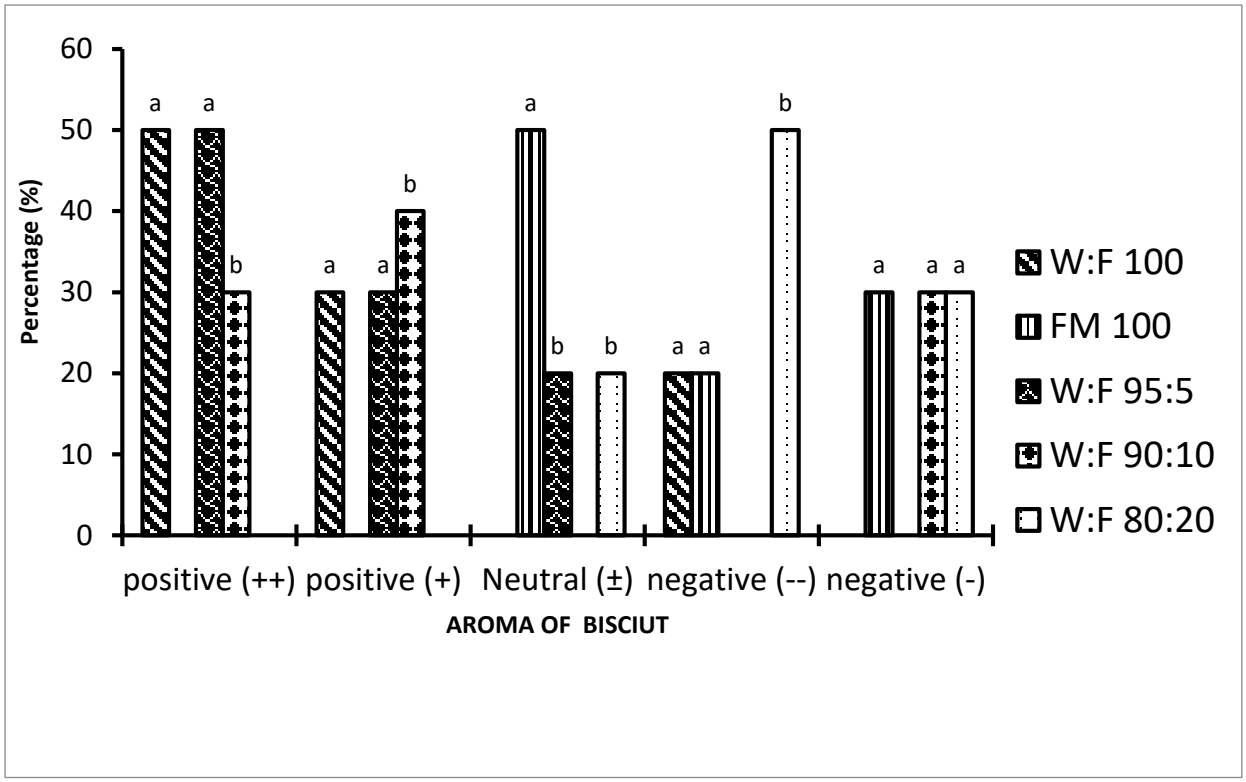
Sample (%)	Moisture (%)	Protein (%)	Fat (%)	Fibre (%)	Ash (%)	Carb (%)	Energy (%)
W:F 100	10.53 ± 1.45[a]	10.75 ± 0.78[a]	2.52 ± 1.00[a]	1.77 ± 0.80[b]	1.47 ± 0.31[a]	72.97 ± 1.46[a]	357.52 ± 3.04[a]
FM 100	14.13 ± 0.60[b]	7.97 ± 0.67[b]	1.43 ± 0.21[a]	4.09 ± 0.37[a]	2.83 ± 0.25[b]	73.47 ± 1.36[a]	352.95 ± 4.62[b]
W:F 95:5	8.88 ± 1.07[a]	10.52 ± 1.30[ab]	1.87 ± 0.33[a]	1.89 ± 0.34[b]	2.20 ± 0.61[ab]	74.44 ± 1.32[a]	356.63 ± 5.23[a]
W:F 90:10	10.17 ± 1.16[a]	9.64 ± 1.22[ab]	1.45 ± 0.25[a]	2.00 ± 0.06[b]	2.32 ± 0.69[ab]	74.42 ± 3.23[a]	349.32 ± 6.80[a]
W:F 80:20	10.31 ± 1.74[a]	9.59 ± 1.03[ab]	1.37 ± 0.33[a]	2.10 ± 0.19[b]	2.83 ± 0.25[b]	73.81 ± 3.34[a]	345.89 ± 6.85[a]

Data are presented as Mean ± Standard deviation (n=5). Values with the same superscript letter(s) along the same column are not significantly different (P < 0.05). W:F 100 = wheat and finger millet at 100%, FM = finger millet at 100%, W:F 95:5 = wheat at 95% and finger millet at 5%, W:F 90:10 = wheat at 90% and finger millet at 10%, W:F 80:20 = wheat at 80% and finger millet at 20%.

Table 2: Proximate Composition of Biscuit

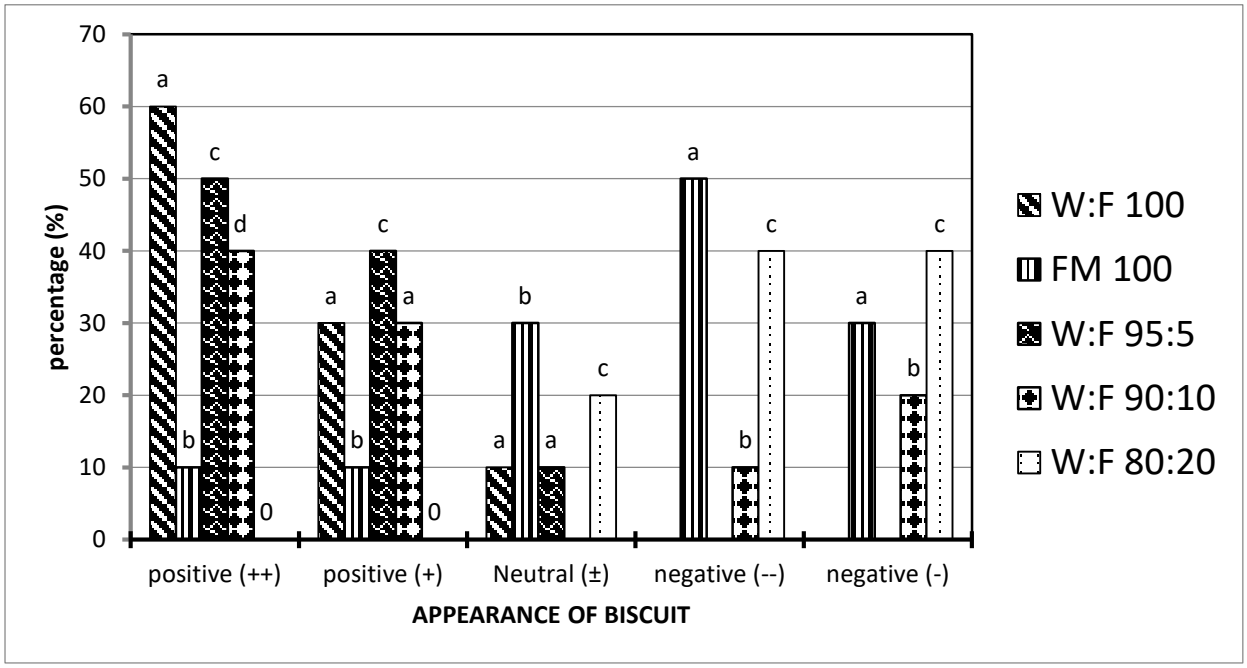
Sample (%)	Moisture (%)	Protein (%)	Fat (%)	Fiber (%)	Ash (%)	Carb (%)	Energy (%)
W:F 100	3.53 ± 0.35[a]	16.09 ± 0.09[a]	7.81 ± 0.10[a]	3.91 ±0.11[a]	3.68 ± 0.10[a]	62.63 ± 0.07[a]	395.19 ± 0.61[a]
FM 100	4.65 ± 0.05[b]	17.52 ± 0.45[b]	7.08 ± 0.13[b]	5.52 ±0.02[b]	4.70 ± 0.21[b]	60.60 ± 0.17[b]	374.17 ± 1.95[b]
W:F 95:5	3.27 ± 0.06[a]	17.23 ± 0.15[b]	7.09 ± 0.12[b]	3.28 ± 0.13[c]	4.02 ± 0.03[a]	66.44 ± 0.11[c]	394.53 ± 1.29[a]
W:F 90:10	3.44 ± 0.10[a]	16.54 ± 0.05[a]	6.97 ± 0.12[b]	3.51 ± 0.11[cd]	4.40 ± 0.17[c]	65.52 ± 0.25[d]	385.34 ± 0.14[c]
W:F 80:20	3.67 ± 0.40[a]	15.30 ± 0.17[c]	7.07 ± 0.29[b]	3.80 ± 0.20[ad]	5.04 ± 0.05[b]	65.07 ± 0.06[c]	381.23 ± 0..64[d]

Data are presented as Mean ± Standard deviation (n=5). Values with the same superscript letter(s) along the same column are not significantly different (P < 0.05). W:F 100 = wheat and finger millet at 100%, FM = finger millet at 100%, W:F 95:5 = wheat at 95% and finger millet at 5%, W:F 90:10 = wheat at 05% and finger millet at 10%, W:F 80:20 = wheat at 80% and finger millet at 20%.



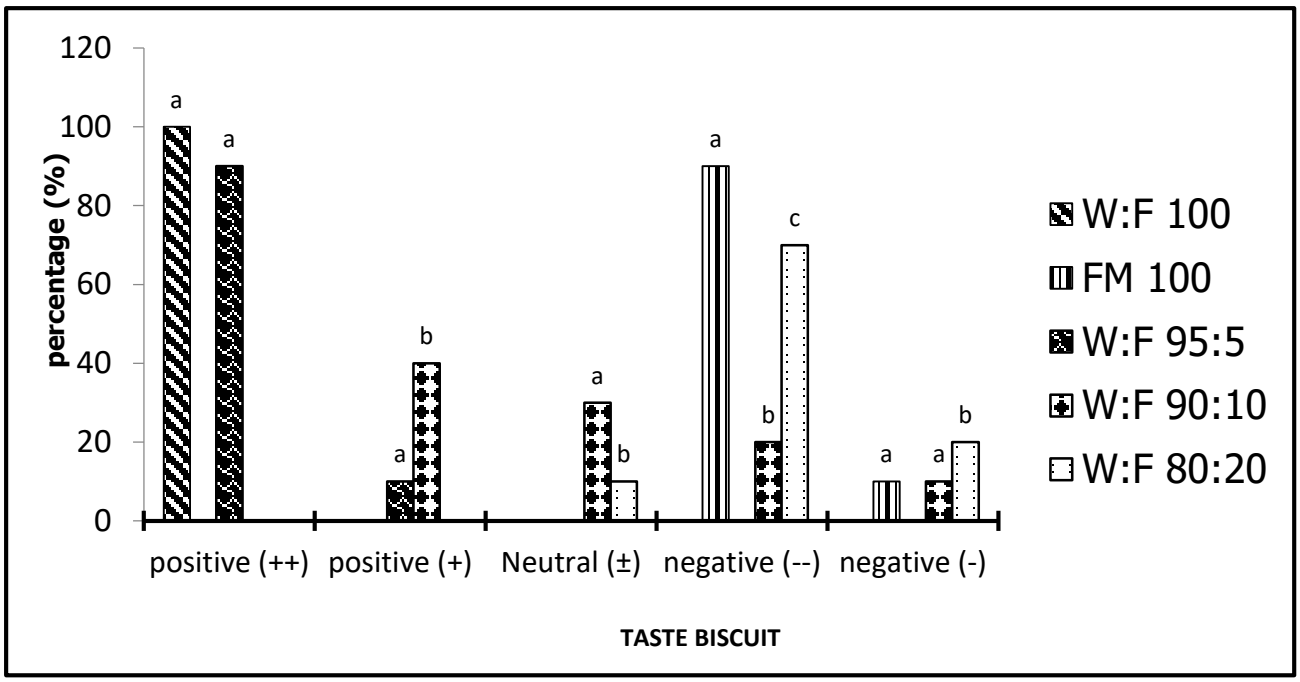
Bars with the different letter (s) are significantly different (at $p < 0.05$).

Figure 1. Sensory evaluation of Biscuit produced from finger millet and wheat flour (Aroma)



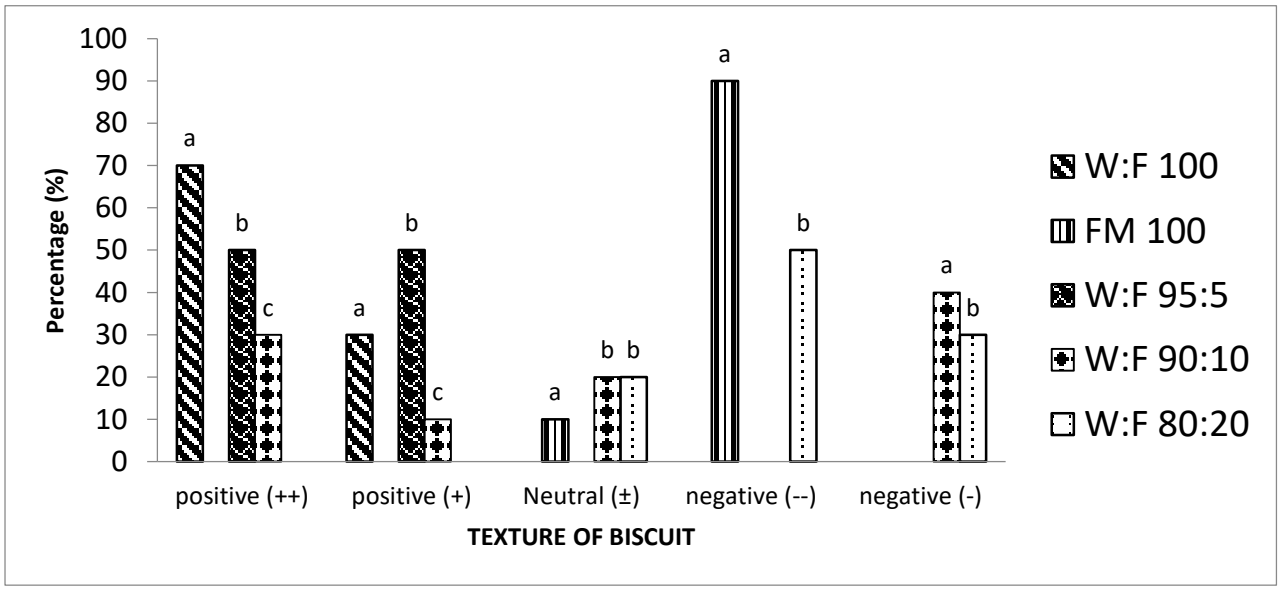
Bars with the different letter (s) are significantly different (at $p < 0.05$).

Figure 2. Sensory evaluation of Biscuit produced from finger millet and wheat flour (Appearance)



Bars with the different letter (s) are significantly different (at $p < 0.05$).

Figure 3. Sensory evaluation of Biscuit produced from finger millet and wheat flour (Taste)



Bars with the different letter (s) are significantly different (at $p < 0.05$).

Figure 4. Sensory evaluation of Biscuit produced from finger millet and wheat flour (Texture)

CONCLUSION

As Millet are reservoir of "nutrition". Based on the results obtained from this study, which revealed the effectiveness of finger millet flour in enhancing nutritional and sensory attributes of Biscuit produced from finger millet and wheat flour. Therefore it can be concluded that incorporation of finger millet flour combined with wheat flour not only made cookies formation easy but also gives best nutritional elements to human health. Additionally, preparation of this product is economical and can be consumed by individuals of all ages.

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