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QUALITY ASSESSMENT OF STIFF DOUGH (*Eba*) PRODUCED FROM *GARI* AND PEARL MILLET (*Pennisetum glaucum)* FLOUR BLENDS

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Abstract
Gari is a major staple food consumed by millions of people in Africa and almost every part of Nigeria. In this study, flours from two Pearl millet (*Pennisetum glaucum*) cultivars (*Jero and Maiwa*) were used in partial replacement of gari for the production of stiff dough (*eba*). The millet grains were subjected to relevant preliminary operations and thereafter converted into flour. The flour was divided into two equal portions of 500 g each. A portion of the flour from each cultivar (250 g) was sieved to have sieved and unsieved flour samples. Gari was produced from TMS 419 cassava cultivar and served as the control. Stiff dough was produced from gari partially replaced with 30%, 50% and 70% of sieved and unsieved millet flours and 100% flour of each millet cultivar making a total of thirteen formulations. The proximate composition, total starch content and sensory evaluation of the stiff dough samples were determined using standard methods. There was significant difference ($p<0.05$) in the chemical composition of the dough produced. The 100% unsieved *Jero* dough had the highest protein content (11.37%) while the control (100% gari) had the lowest (1.53%). The result revealed that dough samples with 70% gari: 30% Unsieved millet (*Jero and Maiwa)* flour blends recorded the highest crude fibre content (*1.12% and 1.15%, respectively*) and there was no significant difference ($p>0.05$) among them. Ash content ranged from 1.58-2.98% with 50% gari: 50% Unsieved *Jero* recording the highest value, while 100% sieved *Maiwa* recorded the least value. The control (100% gari) recorded the highest carbohydrate content (74.33%) while the 100% sieved *Jero* dough recorded the lowest value (49.77%). There was significant difference ($p<0.05$) in the starch content of the dough produced. Starch content of the dough was observed to increase with increase in the proportion of gari. The sensory evaluation results revealed that in terms of general acceptability, dough produced from samples with 30%, 50% sieved *Jero* and 30% unsieved *Jero* and *Maiwa* flour blends compared favourably with the control (100% gari) as they were generally accepted. This result therefore, has shown that, gari can be partially replaced with up to 30% millet flour. Moreover, the result depicted that stiff dough with high nutritional values can be produced from partial replacement of gari with millet flour.

Keywords: *Gari*, pearl millet, *Jero*, *Maiwa*, stiff dough, proximate, starch, sensory

Introduction

Increase in population and food prices have posed a great threat to food security and consequently, the prevalence of diet-related deficiencies in developing countries. Food processors are now faced with the task of creating and discovering other foods with high nutrient value to alleviate the problem in the food value chain (Saleh *et al*., 2013; Gunashree *et al*., 2014). Millet has been found to be highly nutritious with respect to its essential amino acids content, compared to other cereals such as wheat and rice (Mal *et al.,* 2010). Millet contains virtually the required nutrients suitable for large-scale utilization in the manufacture of varieties of products such as baby foods, snack foods and dietary foods in various forms (Mohamed *et al.,* 2007). Among millet, pearl millet is one of the most important crops in tropical and subtropical regions of the world. It is a multipurpose crop grown for food, feed and sustains the lives of majority of people especially the low income groups in several African and south Asian countries (Kumar and Chauhan, 1993). Previous research has shown that pearl millet is one of the most important crops in subtropical regions that may serve as a dietary source of antioxidants (Odusola *et al*., 2013). They are associated with bioactive ingredients, phytochemicals and micronutrients (Mal *et al.,* 2010). However, despite its nutritional value, it is underutilized especially in the Southern and Eastern part of Nigeria.

Gari is one of the most popular fermented staples made from cassava and consumed in Nigeria, primarily as stiff dough with soup and in other parts of West Africa (Makanjuola *et al*., 2012). Dough in this study can be defined as a food made from flours stirred continuously in boiling water to make a stiff homogenous and gelatinized mixture without lumps (Oyango, 2014). In Nigeria, gari is prepared by pouring a certain quantity into boiling water and stirring the mixture evenly to obtain stiff dough known as *Eba*. It is then consumed by forming small balls from the stiff dough and dipping into soup and swallowing it with or without mastication (Irtwange and Achimba, 2009). Gari is a major staple food in Nigeria. Even as a staple food, it has continuously recorded price inflation thus making it unaffordable to most of its consumers. In order to alleviate the cost, its partial replacement with cheaper food alternatives is therefore, an imperative. Research has proved that millet flour on its own is more nutritious than *gari* and its addition in the production of a meal will not only reasonably reduce the high cost of gari but add value to our conventional gari. This study thus, aimed at assessing the quality and acceptability of stiff dough prepared from flour blends of gari and pearl millet

Materials and Methods

Sample Procurement

Freshly harvested cassava roots, TMS 419 cultivar used in in this study to produce gari, was procured from National Root Crops Research Institute (NRCRI), Umudike. The two millet cultivars (*Jero and Maiwa*) used were purchased from Ubani market, all in Abia State.

Production of gari

The method described by Irtwange and Achimba (2009), was adopted in the production of gari. Freshly harvested cassava roots (TMS 419) (100kg) was washed to remove adhering soil, peeled, rewashed and grated with 7.5HP grating machine to obtain cassava mash. The cassava mash was filled into bag and placed on the base of a dewatering machine and allowed to ferment for 24 hours. Thereafter, the fermented mash in the bag was dewatered and pressed with hydraulic press and allowed to ferment overnight. The dewatered cassava cake was then sifted with stainless aluminum screen (1.5-2.0 mm particle size) to remove fibrous materials and toasted with a local heavy shallow moulded aluminum pot to obtain gari. The gari was cooled and milled into flour to have a uniform particle size (0.25mm particle size), after which it was packaged in airtight polyethylene bags.

Production of millet flour

In the production of millet flour, the method described by Fasasi (2009) was adopted. Wholesome millet grains were cleaned, sorted to remove extraneous materials, washed and soaked for 12 hours. Thereafter, the soaked millet grains were drained using a perforated plastic container and oven dried at 65°C for 24 hours. The dried millet grains were milled with hammer mill (Tiger-extuda 6.5 horsepower) into resultant flour to have unsieved millet flour. A portion of the milled flour was sieved with 0.25 mm particle size mesh to obtain fine sieved millet flour. The flour was then packaged in airtight polyethylene bag and kept under ambient temperature until needed.

Production of Stiff Dough (Eba)

The dough was produced using the method described by Onyango (2014). The dough was prepared individually by preparing 350g of gari flour, *Jero* flour, *Maiwa* flour and a mixture of gari/millet flour blends into boiling water (900mls) in an aluminum cooking pot. The gruel formed was continuously stirred and kneaded using a flat wooden spoon until thick homogenous dough without lumps was formed. The cooking pot was covered and the dough was allowed to heat for two minutes while been kneaded with a flat wooden spoon intermittently. The stiff dough formed was then manually moulded to a dome shape and wrapped in a clean transparent polyethylene for further analysis.

Analyses

The proximate composition including; moisture, ash, crude fiber, ash, protein and contents was determined using the conventional method described by AOAC (2005). The starch content was determined with the method described by Goni *et al*. (1997). The sensory evaluation was carried out according to the method described by Iwe, (2002), where twenty panelists including male and female were presented with the stiff dough (*Eba*). They were given the sensory evaluation form to evaluate the following organoleptic parameters: appearance, aroma, mouldability, texture, taste, stickability and general acceptance using a 9-point hedonic scale for grading.

Statistical analysis

All the data obtained were subjected to a one way test statistical analysis of variance (ANOVA) design using SPSS package version 19 at 5% significant level and the means were compared using Duncan's multiple range test.

Table I: Formulation of dough samples (%)

Sample code	White gari	Jero	Maiwa
	Sieved		
101	100	0	0
102	0	100	0
103	0	0	100
104	50	50	0
105	50	0	50
106	70	30	0
107	70	0	30
	Unsieved		
108	0	100	0
109	0	0	100
110	50	50	0
111	50	0	50
112	70	30	0
113	70	0	30

Where: 101= 100% white gari; 102= 100% sieved Jero; 103= 100% sieved Maiwa; 104= 50% gari: 50% sieved Jero; 105= 50%gari:50% sieved Maiwa; 106 = 70% white gari:30% sieved Jero; 107= 70% white gari: 30% sieved Maiwa; 108= 100% unsieved Jero; 109= 100% unsieved Maiwa; 110= 50% white gari:50% unsieved Jero; 111= 50% white gari: 50% unsieved Maiwa; 112= 70% white gari:30% unsieved Jero; 113= 70% white gari: 30% unsieved Maiwa

Results and Discussion

The proximate composition of the stiff dough (*Eba*) produced from *gari* blended with sieved and unsieved *millet (Jero* and *Maiwa*) flours are shown in Table 2. There were significant differences (P<0.05) in the proximate composition of the dough samples. The moisture content of the dough samples ranged from 20.50 to 35.85%. The dough produced with 100% *Jero* had the highest moisture content (35.85%) and the control (100% gari) had the lowest moisture content (20.20%) (Table 2). The low moisture content of the control sample implies that it will have longer shelf life stability than the other dough samples with high moisture content. It was observed that dough produced from sieved flours had higher moisture content (28.45% to 35.85%) than those produced from unsieved flours (21.15% to 27.70%). This could probably be as a result of high water absorption capacity in the sieved flour since they contain the starchy endosperm. Fasasi (2009), in his research reported high water absorption capacity of fermented millet flours. This is evidence that such dough with high moisture content is prone to spoilage by the activities of microorganism and would have short shelf life. The crude protein content of the dough varied significantly (p<0.05) among the dough samples (Table 2). The dough produced with 100% unsieved *Jero* recorded the highest protein content (11.37%) while the control (100% gari) had the lowest value (1.53%). This is an indication that unsieved *Jero* would serve as a good source of protein when blended with gari. However, dough samples with equal proportion of gari and *Jero* (50%:50%) flours had higher protein content in the unseived sample with gari /millet blend than other dough samples among the unseived samples. It was observed that as the proportion of *Jero* flour increases, the protein content of the dough samples increases for both sieved and unsieved gari/millet blends . This is evidence that blending gari with unsieved *Jero* would serve as a means of preventing protein energy malnutrition. This low crude protein content of gari is same as the report given by Okolie *et al.* (2012) which recorded the crude protein content of gari to be 1.46% to 1.77%. There were significant differences (p<0.05) in the crude protein contents of the dough produced from 100% flours of the two millet varieties (*Jero* and *Maiwa*). *Jero* was observed to be higher in crude protein content than *Maiwa*. A significant decrease (p<0.05) in the protein content of dough was recorded as the percentage of gari was increased in each of the dough samples.

The fat content of all the doughs ranged from 0.52 to 2.68%. Dough produced with 100% Unsieved *Jero* recorded the highest crude fat content of 2.68% but was not significantly different from dough produced with 100% unsieved *Maiwa.* This was followed by dough samples with 50: 50 gari:*Jero* and 50:50 gari:*Maiwa* (2.075 and 2.02% respectively). The control recorded the lowest value (0.52%) (Table 2). There was significant difference (P<0.05) among the dough samples. However, no significant difference existed between 100% unsieved *Jero* and 100% unsieved *Maiwa*. It was observed that as the proportion of millet flours increases (for both *Jero* and *Maiwa*), the values of crude fat content increases. The result obtained in crude fat is similar to that obtained by Fasasi (2009) who recorded a crude fat range of 2.4 to 7.2%. The high crude fat content could be attributed to the presence of the bran in the unsieved flour as also reported by Ahmed *et al*., 2009 in his research work. Low fat content as observed in some of the dough samples implies longer shelf stability as high fat content would encourage rancidity. There was significant difference (P<0.05) in the crude fibre contents of dough produced. Dough with 70% gari: 30% unsieved *Maiwa* recorded the highest crude fibre content (1.15%) and was not significantly different from dough sample with 70% gari: 30% unsieved *Jero*. The lowest crude fibre (0.09%) was observed in dough sample with 100% sieved *Jero*. This falls within the range of values (0.48% to 0.66%) reported by

Makanjuola *et al.* (2012). Higher fibre contents were recorded for dough produced from unsieved millet flours (Table 2) and this could be attributed to the presence of the hulls which makes up a higher percentage of the fibre content in millets. When millet flours are sieved, there is decrease in the crude fibre content (Ahmed *et al*., 2013). This can justify the low crude fibre values obtained in the sieved dough samples when compared to the unsieved dough samples. The mineral composition of foods is roughly determined by the ash content which is the non-combustible portion of the food sample (Fasasi, 2009). There was significant difference ($p<0.05$) in the ash content of the dough (*Eba*) samples. The ash content ranged from 1.58 to 2.94% with 50% *gari*: 50% unsieved *Jero* dough recording the highest value (2.94%) but does not vary significantly with samples with higher proportion of gari(Table 2). Dough produced with 100% sieved *Maiwa* recorded the lowest ash content (1.58%). The result revealed decrease in ash content in dough produced from sieved flour samples than dough from unsieved millet flours. A study revealed that ash contents of millets decreases with sieving (Ahmed *et al*., 2013). This explains the high ash content values recorded in the dough prepared from unsieved millet flours and is also in accordance with the report given by Wang *et al.* (1997) where the bran rich fractions of the flour recorded higher ash values. Most of the dough samples from unsieved flours had higher ash content than the control and therefore can be said to be richer in minerals than the control. The carbohydrate content values of the dough ranged from 49.77 - 74.33%. Dough produced with 100% *gari* had the highest carbohydrate content (Table 2). Gari is a basic product obtained from cassava with a carbohydrate content as high as 87% (Okolie *et al*., 2012).

There was no significant difference ($p<0.05$) observed in the carbohydrate content in dough samples produced from 50% gari: 50% sieved *Jero*, 50% gari: 50% sieved *Maiwa* and 50% gari and 50% unsieved *Jero*) dough. It was observed that dough produced from 100% millet flour had lower carbohydrate content for both sieved and unsieved samples.This was significantly different ($p<0.05$) from dough samples produced from the gari-millet composite which had higher carbohydrate content; hence, the increase in the gari content resulted in increase in the carbohydrate content and vice versa. The lower carbohydrate content as observed in the result for samples containing high proportion of millet flour could be attributed to the protein content of millet flours as carbohydrate content is determined by difference. Energy is one of the parameters used in the determination of food quality especially food products designed with high energy requirements (Kanu *et al*., 2009). There was no significant difference ($p<0.05$) observed between the control (308.14Kcal) and dough produced with 70% gari:30% unsieved *Maiwa* (306.72 Kcal) as well as dough produced with 100% sieved *Maiwa* (279.30Kcal) and 50% gari:50% sieved *Jero* dough (278.49Kcal) and also in 100% unsieved *Maiwa* dough (299.54 Kcal) and 70% gari:30% unsieved *Jero* dough (300.01Kcal). The control (100% gari) and 70% gari: 30% unsieved *Maiwa* dough had the highest energy value. This is due to the high gari content which resulted in higher carbohydrate values compared to the other dough samples. The dough produced with 100% sieved *Jero* recorded the lowest energy value (261.84Kcal). Millets which are cereals and gari a root crop product are naturally, high energy food sources (Okaka, 2001). The dough produced can therefore be relied upon as a good source for energy. The starch content of the dough samples ranged from 42.62% to 75.02%. The values varied significantly ($p<0.05$). Dough produced with 100% gari (control) had the lowest starch content (42.62%) while 70%gari: 30% sieved *Jero* dough had the highest (75.02%) and was not significantly different from 70% gari: 30% sieved *Maiwa* (74.56%). The high starch content could be attributed to the fact that the flours were sieved thus leaving behind the endosperm which houses most of the starch in millet grains (Kajuna, 2001). The results are in accordance with the values (62.8 to 70.5%) reported by Taylor (2004) on starch content of millet. When compared to other cereals such as sorghum, the low starch content of pearl millets can be related to its significant protein and lipid content (Nambiar *et al.*, 2011).

The result of the sensory evaluation is shown in Table 4 . The result showed significant differences ($p<0.05$) in the sensory attributes of the dough produced. There were significant differences ($p<0.05$) in the dough in terms of appearance. The control (100% gari) and 70% gari: 30% sieved *Jero* dough were most preferred. The least preferred was 100% unsieved *Maiwa* dough. Dough produced with 100% millet flours had a dark colour due to the presence of the bran as the grains were not decorticated. Decortication has been reported to leave behind the bright coloured endosperm (Liu *et al*., 2012). In terms of aroma, dough produced with 100% gari (control) and 70% gari: 30% unsieved *Jero* dough were most preferred. The least preferred in terms of aroma was dough produced with 100% unsieved *Maiwa* flour dough. The values obtained in terms of mouldability of the dough were significantly different ($p>0.05$) from the control. However, most of the dough samples had no significant difference ($p<0.05$) in terms of mouldability. 50% gari: 50% unsieved *Jero* dough was least preferred. The sticky nature of dough plays a big role especially when the need arises for swallow. The control sample was most preferred in terms of stickability. Aside the control (100% gari), 100% sieved *Jero* dough, 50% gari:50% sieved *Maiwa* dough and 70% gari:30% unsieved *Jero* dough were more preferred. The low preference for samples containing higher percentage of millet flours could be attributed to the low starch content of the flours. The starch constituent in the flour determines how well the dough gels (Abdalla *et al*., 1998) and this could be the chemistry behind the formation of sticky dough by 100% unsieved *Jero* dough as it recorded the lowest starch content. The texture values obtained compared favourably with the control. The least preferred were

100% unsieved *Jero* dough, 100% unsieved *Maiwa* dough and 50% gari: 50% unsieved *Jero* dough. This could probably be attributed to the presence of the bran as they were unsieved. The presence of the bran increased the fibre content (Bagida *et al*., 2011). The taste of the dough produced from 100% gari (control) was most preferred followed by 100% sieved *Jero* dough, 50% gari:50% sieved *Maiwa* dough, 50% gari: 50% sieved *Jero* dough and 70% gari:30% unsieved *Maiwa* dough. There was no significant difference ($p<0.05$) between them. This preference in taste was recorded mostly for dough samples with 70% gari. This is an indication that the good taste of the dough was mainly from gari. However, dough samples partially replaced with 30% millet flours competed favourably with the control. The sensory evaluation results showed that dough samples with 100% gari and the sample partially replaced with 30% *Jero* flour recorded the highest acceptability, followed by dough samples partially replaced with 30% unsieved *Jero* and *Maiwa* . The least preferred dough was the sample prepared with 100% unsieved *Jero*. This could be due to its dark colour, poor aroma, taste and sticky nature.

Conclusion

Food prices are increasing daily thus creating the need for alternatives to staple foods in Nigeria. Gari dough is the most widely consumed dough especially in this part of the country but presently; gari is beyond the reach of many. In this study, pearl millet flour has been found to be an excellent alternative to gari for dough production. Millets have been underutilized especially in this part of the world where it is either not known or is only considered as feed for livestock irrespective of its nutritive value when consumed by human. This could be attributed to the ignorance of its potential as food for human. From the proximate composition and sensory evaluation results obtained, it can be concluded that up to 30 -50% partial replacement of gari with millet flour can be successfully achieved. This will not only reduce the cost of purchasing gari but will also yield a more nutritious dough in terms of protein content as gari is deficient in protein. The result of this study also revealed that dough with high mineral content as observed in the ash content of the dough samples prepared with millet flour. This study has also revealed that when gari-millet dough is consumed, carbohydrate and protein can be said to be invariably consumed thus can help in reducing protein energy malnutrition as well as increase energy value. It is therefore, concluded that millet flours can be incorporated into *gari* dough (*Eba*) especially in this part of the country where gari is predominantly the dough consumed. This will not only improve the nutritional quality of dough but will also, reduce cost of purchasing gari.

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Table 2: Proximate composition and energy value of stiff dough (*Eba*) samples

Sample Code	Moisture content (%)	Crude Protein (%)	Crude fat (%)	Crude Fibre (%)	Ash (%)	Carbohydrate (%)	Energy Value (Kcal/100g)
Gari:*Jero*:*Maiwa*				**SIEVED**			
100:0:0	$20.50^{e}\pm0.10$	$1.53^{f}\pm0.01$	$0.52^{e}\pm0.01$	$0.66^{ab}\pm0.01$	$2.45^{bc}\pm0.01$	$74.33^{a}\pm0.08$	$308.14^{a}\pm0.39$
0:100:0	$35.85^{a}\pm0.05$	$10.14^{b}\pm0.01$	$2.46^{ab}\pm0.01$	$0.09^{e}\pm0.01$	$1.68^{d}\pm0.01$	$49.77^{g}\pm0.06$	$261.84^{e}\pm0.17$
0:0:100	$31.40^{b}\pm0.30$	$10.07^{b}\pm0.01$	$2.38^{ab}\pm0.01$	$0.17^{e}\pm0.01$	$1.58^{d}\pm0.01$	$54.39^{f}\pm0.28$	$279.30^{cde}\pm1.11$
50:50:0	$29.65^{bc}\pm0.15$	$6.48^{cd}\pm0.01$	$1.83^{bc}\pm0.01$	$0.27^{de}\pm0.01$	$2.74^{b}\pm0.01$	$59.02^{d}\pm0.15$	$278.49^{cd}\pm0.49$
50:0:50	$30.50^{bc}\pm0.20$	$6.21^{cd}\pm0.01$	$1.77^{bc}\pm0.01$	$0.21^{e}\pm0.01$	$2.68^{b}\pm0.01$	$58.70^{d}\pm0.27$	$275.63^{d}\pm1.10$
70:30:0	$28.45^{c}\pm0.15$	$3.15^{e}\pm0.01$	$1.28^{d}\pm0.01$	$0.38^{d}\pm0.01$	$2.92^{a}\pm0.01$	$63.81^{c}\pm0.12$	$279.42^{cde}\pm0.54$
70:0:30	$30.70^{bc}\pm0.10$	$3.99^{e}\pm0.01$	$1.23^{d}\pm0.01$	$0.33^{d}\pm0.01$	$2.87^{ab}\pm0.01$	$60.88^{d}\pm0.07$	$270.55^{de}\pm0.37$
				UNSIEVED			
0:100:0	$27.20^{cd}\pm0.10$	$11.37^{a}\pm0.01$	$2.68^{a}\pm0.01$	$0.73^{ab}\pm0.01$	$2.07^{c}\pm0.01$	$56.01^{e}\pm0.14$	$293.10^{bcd}\pm0.43$
0:0:100	$25.60^{d}\pm0.20$	$11.16^{ab}\pm0.02$	$2.56^{a}\pm0.01$	$0.70^{ab}\pm0.01$	$2.02^{c}\pm0.01$	$57.95^{de}\pm0.23$	$299.54^{bc}\pm0.81$
50:50:0	$27.70^{cd}\pm0.08$	$7.76^{c}\pm0.01$	$2.07^{b}\pm0.01$	$0.59^{c}\pm0.01$	$2.98^{a}\pm0.01$	$58.89^{d}\pm0.00$	$285.29^{cd}\pm0.07$
50:0:50	$26.60^{d}\pm0.30$	$7.68^{c}\pm0.01$	$2.02^{b}\pm0.02$	$0.55^{c}\pm0.01$	$2.92^{a}\pm0.01$	$60.22^{c}\pm0.32$	$289.88^{c}\pm1.12$
70:30:0	$21.15^{e}\pm0.05$	$4.43^{d}\pm0.01$	$1.44^{c}\pm0.01$	$1.02^{a}\pm0.01$	$2.94^{a}\pm$o.03	$69.01^{b}\pm0.04$	$306.72^{ab}\pm0.30$
70:0:30	$23.60^{de}\pm0.30$	$4.88^{d}\pm0.01$	$1.51^{c}\pm0.01$	$1.15^{a}\pm0.01$	$2.14^{c}\pm0.01$	$66.71^{bc}\pm0.28$	$300.01^{b}\pm1.22$

Values are mean ± standard deviation of duplicate determinations. Means with the same superscript within the same column are not significantly different (P>0.05)

Table 3: Total starch content of the dough samples

Sample code	Total starch (%)
Gari:*Jero*:*Maiwa*	**SIEVED**
100:0:0	$42.62^{e}\pm0.01$
0:100:0	$69.81^{c}\pm0.01$
0:0:100	$68.11^{cd}\pm0.01$
50:50:0	$73.86^{ab}\pm0.04$
50:0:50	$70.66^{bc}\pm0.03$
70:30:0	$75.02^{a}\pm0.01$
70:0:30	$74.56^{a}\pm0.01$
	UNSIEVED
0:100:0	$64.26^{d}\pm0.01$
0:0:100	$62.68^{de}\pm0.01$
50:50:0	$70.26^{c}\pm0.02$
50:0:50	$67.51^{cd}\pm0.01$
70:30:0	$71.45^{bc}\pm0.02$
70:0:30	***$72.09^{b}\pm0.01$***

Table 4: Sensory evaluation of dough (*Eba*) samples

Sample	Appearance	Aroma	Mouldability	Stickability	Texture	Taste	General acceptability
Gari:*Jero*:*Maiwa*				**SIEVED**			
100:0:0	$8.10^{a}\pm0.85$	$7.55^{a}\pm1.10$	$7.35^{a}\pm1.53$	$7.70^{a}\pm1.42$	$6.90^{a}\pm1.37$	$7.60^{a}\pm1.23$	$7.85^{a}\pm0.93$
0:100:0	$7.20^{ab}\pm1.90$	$6.70^{abc}\pm1.62$	$6.45^{ab}\pm1.93$	$7.10^{ab}\pm2.07$	$6.25^{a}\pm1.94$	$6.65^{ab}\pm2.23$	$6.90^{b}\pm1.89$
0:0:100	$4.30^{ef}\pm2.47$	$4.15^{e}\pm2.21$	$4.50^{cd}\pm1.79$	$4.75^{de}\pm1.71$	$4.75^{bc}\pm2.31$	$4.80^{e}\pm2.21$	$5.05^{bc}\pm2.01$
50:50:0	$6.75^{abc}\pm1.55$	$5.85^{bc}\pm2.21$	$6.90^{ab}\pm1.86$	6.60^{abc}c±1.60	$6.70^{a}\pm1.69$	$6.45^{abc}\pm1.88$	$7.20^{ab}\pm1.51$
50:0:50	$5.75^{cd}\pm2.12$	$5.95^{bc}\pm1.76$	$5.90^{ab}\pm1.48$	$6.25^{bc}\pm1.58$	$5.60^{ab}\pm1.79$	$6.20^{bcd}\pm1.82$	$6.30^{b}\pm1.92$
70:30:0	$7.70^{a}\pm1.03$	$6.85^{abc}\pm1.75$	$6.85^{ab}\pm1.93$	$6.55^{abc}\pm1.14$	$6.45^{a}\pm1.67$	$7.05^{ab}\pm1.50$	$7.75^{a}\pm1.02$
70:0:30	$6.75^{abc}\pm1.58$	$6.70^{abc}\pm1.55$	$6.25^{ab}\pm2.07$	$6.35^{abc}\pm2.11$	$6.25^{a}\pm1.92$	$6.90^{ab}\pm1.33$	$6.55^{b}\pm1.64$
				UNSIEVED			
0:100:0	$4.30^{ef}\pm2.56$	$5.25^{de}\pm2.40$	$4.50^{cd}\pm2.50$	4.20e±2.14	$3.85^{c}\pm2.23$	$5.00^{de}\pm2.25$	$4.40^{c}\pm2.33$
0:0:100	$3.90^{f}\pm2.55$	$4.05^{e}\pm2.21$	$5.60^{bc}\pm2.44$	$4.45^{de}\pm2.01$	$4.20^{c}\pm1.96$	$4.95^{de}\pm1.99$	$5.25^{bc}\pm1.94$
50:50:0	$4.85^{de}\pm2.20$	$4.90^{de}\pm2.15$	$3.85^{d}\pm2.37$	$4.30^{de}\pm2.85$	$3.65^{c}\pm2.25$	$5.20^{bcd}\pm2.33$	$5.20^{bc}\pm2.26$
50:0:50	$5.55^{cde}\pm2.06$	$5.65^{cd}\pm2.18$	$6.30^{ab}\pm2.25$	$5.60^{cd}\pm2.39$	$6.40^{a}\pm1.93$	$6.20^{bcd}\pm1.82$	$6.60^{b}\pm1.93$
70:30:0	$7.40^{ab}\pm1.42$	$7.20^{ab}\pm1.44$	$6.65^{ab}\pm1.95$	$6.10^{bc}\pm2.24$	$6.35^{a}\pm2.13$	$6.15^{bcd}\pm1.87$	$7.05^{b}\pm1.73$
70:0:30	$6.25^{bc}\pm2.51$	$6.80^{abc}\pm1.76$	$6.65^{ab}\pm1.69$	$6.75^{abc}\pm1.58$	$6.95^{a}\pm1.43$	$6.85^{ab}\pm0.87$	$7.00^{b}\pm1.33$