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Effects of Different Fermenting Agents on Proximate Composition and Sensory Evaluation of *Masa* - A Fermented Puff Fried Batter

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ABSTRACT: Fermentation improves the shelf life, texture, taste and aroma, nutritional value and digestibility and also lowers the content of antinutrients of fermented meals. This study investigated the effect of different fermenting agents on the quality of *masa*. The rice grains were sorted, cleaned, washed and soaked, wet milled and fermented separately with baker's yeast, lactic acid culture (yogourmet) and *tsamiyan gaye* (citric acid) respectively. The final batter was fried and package for analysis. The different fermenting agent had significant ($p<0.05$) effect on all parameters measured. Masa fermented with lactic acid bacteria culture (LAB) had the highest value of 9.25% 0.83%, 1.01% and 18.51% for protein, crude fibre ash and fat content respectively while yeast fermented masa had higher respective value of 21.46% and 50.12% for moisture and carbohydrate content. The pH of masa sample is within the r range of 3.76-5.57 and titritable acidity of 0.05-0.17. The sensory evaluation was carried out to assess the acceptability of the masa samples. However, all *masa* samples were generally accepted but baker's yeast fermented masa had higher means scores for overall acceptability (7.40). Tsamiyan gaye (citric acid) and LAB culture can be used as an alternative to baker's yeast for preparation of *masa*.

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Masa (*waina)* is a cereal-based fermented cake popularly consumed as snack or adjunct to breakfast porridges in Nigeria, Ghana, Côte d'Ivoire and some other West African countries (Owuzu-Kwarteng and Akanbada, 2014). It is one of such indigenous streets vended fried fermented puffed batters that is mainly produced from flour of maize (*Zea mays*), millet (*Pennisetum typhoideum*), sorghum (*Sorghum vulgare*) or rice (*Oryza sativa*) and consumed by all age groups in the Northern regions of Nigeria (Samuel *et al.*, 2015; Akande *et al*., 2018). There are different types of masa base on the cereals used, these are; *Masa Shinkafa, Masa Masara, Masa Gero* and *Masa Dawa.* The major raw materials and ingredient required are cereal grains (rice, millet, sorghum or millet), salt, sugar, yeast (leavening agent), *kanwa* (potash) and vegetable oil. The preparation of masa involves pre-fermentation treatments of cereals grains which are largely dependent on the type of cereal used. In general, processing operation such as steeping, washing, drying, milling, fermentation (overnight), addition of yeast, salts and sugars and dilution of fairly thick batter with trona or baking powder before frying are generally employed by *masa* producers (Igwe *et al.,* 2013). Additionally, it is predominantly a carbohydrate-based food that is low in protein quality (Ochoa- Martinez *et al.,* 2016). Several studies have been carried out to fortified *masa* so as to improve its nutritional quality. Samuel *et al*. (2015) reported rice-based *masa* enriched with soybean and crayfish with improved nutritional qualities than whole rice *masa.* Malomo and Abiose (2019), discovered that the substitution of maize with 20% *acha* and 20% soybean significantly increased the essential amino acids,

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protein efficiency ratio, essential amino acid index, and biological value of *masa*. Similarly, Akande *et al.*, (2018) reported that enrichment of rice with grain amaranth and carrots have the potential of raising the nutritional status of a low-protein rice-based *masa*. Also, Ayo *et al.* (2012) reported enrichment of millet-based masa with beneseed paste to improve the protein content of the composite masa These are indications that addition of legumes to cereals improved the nutritional quality of *masa*. Processing of food relies on a series of preservative technologies developed to enhance quality, safety, and acceptability, one of which is fermentation (Adekoya *et al.*, 2017). Fermentation is one of the oldest methods of food processing. Fermentation being a low-cost technology improves the digestibility and functionality of foods and facilitates food detoxification thereby extending the shelf life (Colak *et al.*, 2012; Chilaka *et al*., 2016). *Masa* as one of the fermented product of rice which is still produced traditionally in the home by the local women and the fermentation is spontaneous and uncontrolled (Igwe *et al.*, 2013). Moreover, Ranasalva and Visvanathan, (2014) reported that lactic acid fermentation has been found to reduce the risk of growth of pathogenic microorganisms in the food. Lactic acid fermentation contributes to the safety, health, organoleptic, technological and nutritional qualities of foods (Soro-Yao *et al*., 2014; Olaoye, *et al.,* 2017). Similarly, utilization of lactic acid bacteria in fermentation detoxifies toxins and is a milder method since it preserves the flavour and nutritional value of foods (Chelule *et al*., 2010). However, there is little information available on the use of lactic acid bacteria starter culture in fermented rice grains for *masa* production. Therefore, the objective of this research is to evaluate the effect of different fermenting agent on proximate composition and sensory evaluation of *masa* meal.

MATERIALS AND METHODS

Source of raw material: The rice grains, tsamiyan gaye were purchased from Kure ultra-modern market Minna, Niger state, Nigeria while lactic acid bacteria culture (yogourmet) used was purchased from Omni yogourmet ILMI AVE, Minna Niger State. All chemicals used were of analytical standard.

Preparation of masa samples: The *masa* (*waina*) was prepared according to slight modification of Maiangwa *et al*. (2013). The rice grains (600g) was weighed and were carefully sorted to remove stones and other foreign materials such as pieces of metals, dust and any other foreign materials. 550g was weighed, washed with tap water and soaked in clean container for 12 hours. while the remaining 50g was cooked separately. Thereafter, the soaked rice grains were washed and drained in a clean container after which 50g of the cooked rice was added to improve its gelatinization properties and wet milled with distilled water in the ratio of 1:2 (w/v) in sterile fermentation container using a blender. The batter was divided into three (3) in which 5g of different fermenting agent (yeast tsamiyan gaye and starter culture) were added separately and was allowed to ferment for 5 hrs. After fermentation, batter was vigorously mixed with a whisk to incorporate air. The batter was measured with a medium sized spoon and fried in a pan with individual cup like depression in which 30cm^3 of oil has been added. The *masa* products were packaged in a plastic container with cover and subjected to analysis.

Determination of quality properties of masa samples: The proximate composition of the *masa* samples was determined as described by AOAC. (2005) for moisture, protein, fibre ash and carbohydrate value.

Determination of pH and total titratable acidity (TTA): The pH of the *masa* samples was determined according to the procedure described by Onwuka (2005). About 5g of each sample was mashed and weighed into 50 ml of distilled water in a beaker to form a homogenous solution. It was allowed to stand for 30 minutes in 40 º C water bath. The samples were then filtered using Whatman No. 1 filter paper and the supernatant dispensed into a 50 ml beaker, mixed thoroughly and the pH measured with pH meter. The pH meter was calibrated with standard buffer solution of pH 4.0 and 7.0. The TTA was carried out according to AOAC (2005) method. Each *masa* sample (1.0 g) was mixed with warm water and volume was made up to 10 ml in 100 ml conical flask; each sample was shaken vigorously and filtered. The filtrate was titrated with 0.1 N NaOH using phenolphthalein as indicator. Percent acidity was calculated by using the following expression:

$$TTA(\%\ lactic\ acid) = \frac{0.0090 \times volume\ of\ NaOH\ used\ \times 100}{weight\ of\ sample}$$

Sensory evaluation of masa samples: Sensory evaluation of *masa* samples was determined using the method described by Iwe, (2002). The organoleptic properties of *masa* samples were examined by a panel of twenty (20) judges (final year undergraduate students). The panelists were asked to rate the samples for taste, appearance, texture, flavor and overall acceptability using a 9 point Hedonic scale where 1 to 9 represent dislike extremely (1) to like extremely (9) with 9-like extremely, 8-like very much, 7-like moderately, 6-like slightly, 5-neither like nor dislike, 4-dislike slightly, 3-dislike moderately, 2-dislike very much, 1-dislike extremely.

RESULT AND DISCUSSION

The result of the proximate composition of the sample is shown in table 1 above. There was significant ($p < 0.05$) difference between the proximate composition of all *masa* samples. The moisture content ranged from 21.46-23.81% for *masa* fermented with baker's yeast, starter culture and *tsamyan gaye*. However, this disagrees with value of 35.15% - 44.12% reported by Maiangwa *et al.* (2013). The low moisture content may be due to differences in processing condition such as the preparation of masa and duration of frying time. The protein value ranged from (8.77-9.64%) with *tsamiyan gaye* and starter culture fermented masa having highest value. Although this value falls within the range of (8.15-12.57%) reported by Dashen *et al.* (2016) and value of 7.33-8.63% by Maiangwa *et al.* (2013). The improved protein content in LAB and *tsamiyan gaye* (citric acid) fermented masa may indicate that fermenting *masa* with lactic acid bacteria (LAB) starter culture may improve it protein content as Olaoye, *et al.* (2017) reported that lactic acid fermentation has been reported to contributes to the safety, health, organoleptic, technological and nutritional qualities of foods. Also Aburime *et al.* (2020) reported that citric fermentation significantly increases the protein contents of foods due to low pH provided by the citric acid thus, facilitating solubilization of protein, resulting in higher protein yields. The crude fibre of the *masa* samples ranges from 0.37 – 0.77% with starter culture fermented *masa* having highest value. The higher crude fibre may be advantage in improving the nutritional content of masa as fibre aid in digestion and promote health (Elleuch *et al.,* 2011). The ash content ranges from 0.51-0.90%. This value was lower compared to value of 0.72-1.12% reported by Mainagwa *et al.* (2013). The fat content ranges from 18.51-25.51%, these values are higher than (12.06-15.80%) reported by Maiangwa *et al*. (2013). The high fat content recorded despite the low quantity of oil used for frying may be due to the tendency of the batter absorbing fat while frying and frying time. This may affect the keeping quality of the *masa*. the carbohydrate content of the samples ranges from 39.92-50.12 with control yeast fermented *masa* recording the highest value while sample C, (*tsamiyan gayen*) having the lowest value the high carbohydrate value from yeast fermented *masa* indicate a good source of energy to the consumer.

Table 1: Proximate composition of masa samples

Samples	Moisture	Crude protein	Crude fibre	Ash	Fat	CHO
A	21.46^c	$8.77±0.01^c$	$0.37±0.01^c$	$0.51±0.01^c$	$24.31±0.01^b$	$50.12±0.71^a$
B	$22.81±0.01^b$	$9.25±0.01^b$	$0.83±0.01^a$	$1.01±0.01^a$	$18.51±0.01^c$	$47.70±0.01^b$
C	$23.81±0.01^a$	$9.64±0.01^a$	$0.77±0.01^b$	$0.90±0.01^b$	$25.51±0.01^a$	$39.92±0.70^c$

Results with different superscripts along the column are significantly different (p<0.05).
Keys: *Sample A = Yeast: Sample B = Starter Culture: Sample C = Tsamiyan gaye (citric acid)*

Table 2: Sensory properties of masa samples

Samples	Appearance	Flavour	Taste	Colour	Texture	Overall acceptability
A	$7.80±0.92^a$	$6.90±0.57^a$	$7.20±1.03^a$	$7.40±1.26^a$	$6.10±1.45^a$	$7.40±0.97^a$
B	$6.80±0.63^b$	$6.20±1.31^a$	$6.00±1.25^b$	$5.90±0.74^b$	$6.10±0.99^a$	$6.70±0.95^b$
C	$6.50±0.85^b$	$6.00±1.32^a$	$5.70±1.49^b$	$5.90±0.99^b$	$6.00±1.25^a$	$5.90±0.99^b$

The results are mean ± SE. Results with different superscripts along the column are significantly different (p<0.05).

The result of the sensory analysis is presented in table 2 above. It revealed a significant difference ($p < 0.05$) in all parameters measured except texture when compared with sample A (baker yeast). However masa fermented by starter culture and *tsamiyan gaye* were not affected significantly ($p < 0.05$) in terms of appearance, flavor, taste, color, textures overall acceptability. The average mean score for appearance of masa fermented by baker's yeast, LAB and *tsamiyan gayen* (citric acid) are 7.80, 6.80 and 6.50 respectively. The flavor was also score good, although LAB and *tsamiyan gaye* fermented masa were score lower due to the flavor of the fermenting agent. The average mean score for taste were 7.20, 6.20 and 5.70 for baker's yeast, LAB and *tsamiyan gaye* fermented *masa*. The low score for tsamiyan gaye may be due to sour taste due to slight sour taste which may be attributed to the production acidity as a result of the fermenting agent used. The texture was not affected regardless of the fermenting agent used. In addition, overall acceptability was scores as 7, 40, 6.70 and 5.90 for yeast, LAB and *tsamiyan gaye* fermented masa.

Table 3: Tatritable Acidity (TTA) and of masa samples

Samples	pH	TTA
A	5.57^a	0.05^c
B	4.70^b	0.07^b
C	3.76^c	0.17^a

There was a significant difference ($p<0.05$) between the pH and TTA of all the samples. The pH ranged from 3.76 to 5 57. This values are within the range of 3.7-5.0 reported by Dashen *et al.* (2016). The TTA ranges from 0.05 – 0.17. It was observed that there was a relationship between the two parameters. Hence, the lower the acidity, the higher the pH and vice versa. The higher acidity and low pH in *tsamiyan gaye* (citric acid) fermented *masa* may be due to the ciric acid produce at the end of the fermentation time. These acid are responsible for drop in pH of *masa* and hence, extend the shelf life by retarding the activities of spoilage microorganism'

Conclusion: Masa can be fermented with *tsamiyan gaye* (citric acid) or lactic acid bacteria culture (LAB) as an alternative to yeast. Also, for improved nutrient and safety, citric acid or LAB is highly recommended as it improves protein, ash and increased acidity. All *masa* samples were generally accepted irrespective of the fermenting agent.

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