Original Research Article

SENSORY QUALITIES AND MICRONUTRIENT COMPOSITION OF TORTILLAS MADE FROM RICE FLOUR FOR THE PRODUCTION OF SHAWARMA

ABSTRACT

The purpose of this study was to evaluate the acceptability and micronutrient quality of rice flour tortillas used to make shawarma. Rice flour was made by processing and dry milling paddy rice. Four samples were created by adjusting the proportion of rice-flour with xanthan gum. The samples' sensory and micronutrient characteristics were examined. The results demonstrated that adding xanthan gum raised the micronutrient value. Sample RIS0 had the lowest levels of vitamins (7.00, 0.03 mg/100g) and minerals (1,40, 0.05, 2.92 mg/100g), whereas sample RIS3 had the highest levels of vitamins (17.00, 0.14 mg/100g) and minerals (2.10, 0.58, 5.05 mg/100g). Since the sensory rating trials showed significant variations ($p<0.05$) in texture, taste, and flavor among samples, sample RIS3 has the highest acceptance (7.10). This is because sample RIS3 yielded a product with the lowest moisture content, flexible texture, and maximum overall acceptability.

Introduction

Chopped chicken, beef/lamb, or a combination of meats are cooked on a spit and then chopped into small pieces to make shawarma, a classic Arab cuisine (Nwosu, *et al*. 2024). Peppers and tahini—a paste produced from sesame seeds and oil are used to season it. It is usually wrapped in pita bread and served with mayonnaise and a few vegetables. According to Rooney and Serna-Saldivar (2003), maize is typically used to make flour, tortillas, snacks, steamed goods, and breakfast cereals. The primary source of calories and protein in maize tortillas is the grain, however the quality of the protein is low due to its lack of key amino acids like tryptophan and lysine (Reyes-Moreno *et al.*, 2013). A wheat flour tortilla is a light-colored, circular, chemically-leavened flatbread that originated in Mexico. The soft texture and light color of wheat-flour tortillas are two of the most appealing qualities that customers look for. Typically, tortillas are made with bleached and refined wheat flour, which have dietary fiber level of 2.4g and protein value of 10.5g/100g, respectively (USDA, 2017).

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Celiac syndrome includes a number of disruptions, such as nutritional deficiencies and disorders of absorption. Among the cereals that can be tolerated are sorghum and rice. As a result, creating low-gluten goods is essential, but it also presents a significant technological hurdle.In recent years, other types of flour have been utilized in place of wheat flour to make ready-to-eat morning cereals and snacks (Pardhi *et al.,* 2019). Thus, the purpose of this study is to evaluate the nutritional value, acceptability, and sensory appeal of making shawarma tortillas with rice flour as opposed to wheat and maize flour.

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Materials and methods

Procurement of Raw Materials: The Adani market in Enugu State, Nigeria, is where the paddy rice was bought. Ogige market in Nsukka, Enugu State, was the source of the remaining ingredients. We bought xanthan gum from a chemical store in Onitsha, Nigeria's Anambra State.

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Processing of Rice Flour

After thoroughly cleaning the paddy raw rice of contaminants, it was steeped in water for four hours. The paddy raw rice was rinsed and parboiled with hot water for approximately five hours on low heat after the water was changed after four hours and allowed to soak for another four hours. The cooked paddy rice was parboiled, then sieved to remove any remaining water. It was then placed on a drying mat and allowed to dry in the sun for 72 hours. To create white polished rice, the dried cooked paddy rice was dehusked. A hammer mill is then used to crush the white rice into flour.

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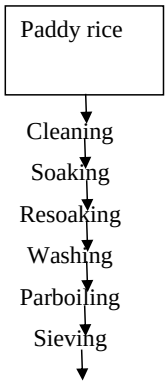
After passing through a 100-mesh sieve, the resulting rice flour was placed in low-density polyethylene (Arendt and Zannini, 2013). Figure 1: Displays the rice flour processing flow chart.



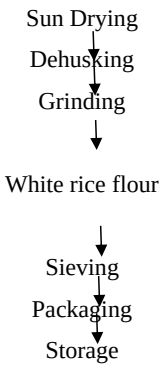


Fig 1: Rice flour processing
Source: Arendt and Zannini, (2013)

Table 1**: Rice Flour for Tortilla Production**

SAMPLE BLENDS	RIF(g)	XIG(g)
RISX	**100**	**0**
RISA	**90**	**0.81**
RISB	**70**	**0.61**
RISC	**50**	**0.41**

Tortilla Production Process

The dry components (rice flour, baking powder, salt, xanthan gum, and salt) were weighed. After two minutes of mixing the dry ingredients, vegetable oil was added and combined for a further six minutes. After adding measured warm water, the mixture was stirred for an additional five minutes, resulting in the formation of a dough. The dough was placed in a basin with a damp towel over it to rest. The dough was separated and formed into balls with the hands after five minutes of rest. After being flattened using rollers, the dough balls were toasted for 55 seconds in a toasted fryer. Prior to analysis, cooked tortillas were placed in polyethylene (PE) bags and allowed to cool to room temperature for three minutes. Figure 2 depicts the flow chart for tortilla production (Cepeda 2000).

Ingredients

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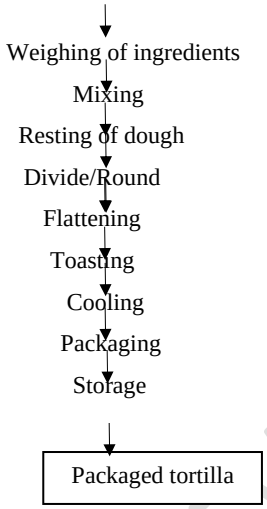

Figure 2: Tortilla Production

Source: Cepeda.(2000)

Identification of a Few Chosen Micronutrients

The colorimetric approach, as outlined by Pearson (1976), was used to determine the vitamin B1 level. According to AOAC (2010), the fluorometric method was used to determine the riboflavin content. Using an atomic absorption spectrophotometer, the mineral content of a sample was assessed for magnesium (Mg), calcium (Ca), and iron (Fe), according to AOAC (2010).

Sensory Evaluation of tortilla

The tortilla samples' appearance, texture, flavor, scent, taste, aftertaste, and overall acceptability were assessed using sensory evaluation. According to Iwe (2014), a 9-point hedonic scale was used for this, with 9 denoting "extremely like" and 1 denoting "extremely dislike." The twenty panelists were students from the University of Nigeria. After being briefed on testing jargon, the panelists were asked to assess the different samples for the previously mentioned qualities. In between each sensory evaluation step, they were given water to clean their mouths. The sensory scores were analyzed statistically to get the two most preferential samples.

Sensory Evaluation for shawarma

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Shawarma was made using the top two tortilla samples. To assess the shawarma samples' color, crust, aroma, crumb texture, taste, and general acceptability, a sensory evaluation was conducted 24 hours after baking. Twenty (20) panelists were chosen from the University of Nigeria, Nsukka's Department of Food Science and Technology.

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Experimental Design and Data Analysis

A completely randomized design will be used to set up the experiment (CRD). Duplicate determinations were used to compute the data's means and standard deviations. The Statistical Package for Service Solution (SPSS version 23) was used to perform One Way Analysis of Variance (ANOVA).

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Results and discussion

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Vitamins Compositions of Tortilla Samples Produced from Rice Flour

The vitamin composition of the tortilla samples were shown in Table 2

Vitamin B1

In recent years, different types of flour have been employed to make ready-to-eat morning cereals and snacks instead of wheat flour (Pardhi et al., 2019). Assessing the acceptability, sensory appeal, and nutritional value of making shawarma tortillas with rice flour instead of wheat and maize flour is the aim of this study.

Table 2: Vitamins (mg/100g) composition of tortilla bread samples produced from rice flour

Tortilla Sample	Vitamin B1	Vitamin B2
RIS0	7.00^{a}±1.41	0.03^{a}±0.00
RIS1	11.50^{b}±0.71	0.05^{b}±0.00
RIS2	12.50^{b}±0.71	0.08^{c}±0.01
RIS3	17.00^{c}±1.41	0.14^{d}±0.01

The values are the means ± standard deviation of duplicate determinations. In the same column, means with different superscripts differ considerably ($p<0.05$). The key RISO stands for 100% rice flour tortilla bread, RIS1 for 90% rice flour plus 0.81% xanthan gum, RIS2 for 70% rice flour plus 0.61% xanthan gum, and RIS3 for 50% rice flour plus 0.41% xanthan gum.

Vitamin B2

The tortilla samples had vitamin B2 concentrations ranging from 0.03 to 0.14 mg/100g. The readings were less than the 0.17 to 0.95 mg/100g of biscuits made from composite flours that Emojorho et al. (2023) reported. The samples differed significantly from one another ($p<0.05$). Sample RISO had the lowest value, 0.03 mg/100g, whereas sample RIS3 had the highest value, 0.14 mg/100g. It was shown that when the amount of xanthan gum inclusion reduced, the value increased. Another B-complex vitamin that supports youthful vitality and nourishes skin and blood vessels is vitamin B2 (Poonia and Pandey, 2022).

Minerals Composition of Tortilla Samples Produced from Rice Flour

The mineral content of the tortillas sample are shown in table 3

Calcium

The tortilla samples had calcium contents ranging from 1.40 to 2.10 mg/100g. The values were less than those reported by Aniemena et al. (2024) for composite flour blends, which were 9.02 to 9.02 to 12.58 mg/100g. None of the samples differed significantly ($p<0.05$). Sample RIS0 had the lowest value (1.40 mg/100g), whereas sample RIS3 had the highest value (2.10 mg/100g). This is because xanthan gum contains calcium as a nutrient of its own and is a rich source of calcium. Rice contains micronutrients such vitamins, minerals, and secondary metabolites in addition to being a significant source of energy (WHO, 2010). Calcium is necessary to keep the entire body healthy. It guarantees healthy muscle and nerve function in addition to maintaining strong bones (Piste et al., 2013).

Magnesium

The magnesium concentration of the tortilla samples ranged from 0.05 to 0.58 mg/100g. These results fell short of the 50.63 to 56.50 mg/100g for composite flours that Chiedu et al. (2024) reported. There was a significant difference between the samples ($p<0.05$). Sample RIS3 had the highest value (0.58 mg/100g), whereas sample RIS0 had the lowest value (0.05 mg/100g). In addition to being an important source of energy, rice provides micronutrients like vitamins, minerals, and secondary metabolites (WHO, 2010). The body needs magnesium, the fourth most prevalent cation, for a wide variety of structural, metabolic, and regulatory functions.

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Table 3: Mineral content (mg/100g) of samples of tortilla bread made with rice flour

Samples	**Calcium**	**Magnesium**	**Iron**
RIS0	$1.40^{a} \pm 0.14$	$0.05^{a} \pm 0.07$	$2.92^{a} \pm 0.12$
RIS1	$1.50^{a} \pm 0.21$	$0.28^{ab} \pm 0.25$	$4.30^{b} \pm 0.14$
RIS2	$1.75^{a} \pm 0.35$	$0.37^{ab} \pm 0.04$	$4.40^{b} \pm 0.57$
RIS3	$2.10^{a} \pm 0.42$	$0.58^{b} \pm 0.11$	$5.05^{b} \pm 0.07$

Iron

The samples of tortillas had iron contents ranging from 2.92 to 5.05 mg/100g. The results were less than the 50.63–56.50 mg/100g that Ihedinachi *et al.* (2025) reported. The samples showed a significant difference ($p<0.05$). Sample RIS0 (100% rice flour) had the lowest value (2.92 mg/100g), whereas sample RIS3 had the highest value (5.05 mg/100g). Both haemoglobin and myoglobin, which are involved in the transport of oxygen, contain the majority of the iron in the body (Sant-Rayn *et al*., 2013).

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Sensory scores of Tortilla samples from Rice flour

Table 4 shows the sensory scores of tortilla from rice flour

Appearance

Sample RISO (100% rice flour) has the lowest value (6.30), whereas sample RIS1 (90% rice flour and 0.81% xanthan gum) has the greatest value (6.95). The tortilla samples' sensory evaluations of appearance did not differ significantly. This is because xanthan gum functions as a food additive and takes on a color comparable to the primary raw material; therefore it doesn't provide any unique colour to the samples. This outcome is consistent with Shalini and Laxmi's (2007) findings. In the investigation of the impact of hydrocolloids on the rheological properties of whole-wheat dough and the quality of chapattis, they came to the conclusion that the inclusion of hydrocolloids had no discernible effect on the color of the chapattis.

Aroma

Sample RS2 (70 rice flour and 0.61 xanthan gum) had the lowest sensory score (6.00) for tortilla scent, whereas sample RIS1 (90 rice flour and 0.81 xanthan gum) had the highest score (6.50). With values of 6.05, 6.50, 6.00, and 6.45, respectively, it was found that the

sample from the control sample RIS0 had an increasing value; nevertheless, there was no significant ($p>0.05$) difference with decreasing xanthan gum incorporation. The findings demonstrated that adding xanthan gum to the tortilla samples did not give them a unique scent of their own, and the rise in values was explained by customer preferences.

Texture

The tortilla bread texture sensory score ranged from 5.40 to 6.70. Sample RIS2 had the highest score (6.70), whereas sample RIS0 had the lowest value. With scores of 6.65 and 6.55, respectively, the control sample differed considerably ($p<0.05$) from the other samples, such as RIS1 and RS3.

As xanthan gum can bind water to create a gel-like structure that may increase the elasticity and chewiness of baked goods, the results showed that adding xanthan gum gave the tortilla bread an acceptable texture. Even at lower concentrations, adding xanthan gum increases the dough's binding capacity, giving the dough a more cohesive and structured texture. The findings of the study Improving the Nutritional as well as Textural Attributes of Wheat Flour Tortillas (Anton, 2008) are consistent with this one.

Table 4: Sensory evaluation ratings of rice flour-made tortilla bread samples

Tortilla sample	Appearance	Aroma	Texture	Taste	Flavour	After taste	Overall acceptability
RIS0	6.30^{a} ±2.11	6.05^{a}±2.04	5.40^{a}±2.37	4.90^{a}±2.10	4.40^{a}±1.98	5.20^{a}±2.12	6.10^{a}±1.65
RIS1	6.95^{a} ±1.28	6.50^{a}±1.40	6.65^{b}±1.46	5.50^{ab}±1.64	5.40^{ab}±1.27	5.35^{a}±1.39	6.70^{ab}±1.53
RIS2	6.50^{a} ±1.59	6.00^{a}±1.65	6.70^{b}±1.38	5.90^{ab}±1.74	5.70^{b}±1.46	5.35^{a}±2.08	6.50^{ab}±1.40
RIS3	6.90^{a} ±1.59	6.45^{a}±1.50	6.55^{b}±1.36	6.15^{b}±1.57	5.95^{b}±1.79	6.15^{a}±1.81	7.10^{b}±1.17

Taste

The tortilla bread's taste received sensory ratings ranging from 4.90 to 6.15. The tortilla samples' sensory evaluations for taste show a notable variation. The value showed that the tortilla bread made with rice flour and xanthan gum added an acceptable taste more than the tortilla bread made with 100% rice flour. The lowest score (4.90) was recorded in sample RIS0, and the highest score (6.15), recorded in sample RIS3. It was found that xanthan gum doesn't change the flavor of tortillas because it doesn't have a distinct taste. However, the tastes of the consumer can be blamed for these discrepancies.

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Flavour

The bread's flavour received sensory ratings ranging from 4.40 to 5.95. Sample RS0 (100% rice flour) had the lowest score, 4.40. With scores of 5.40, 5.70, and 5.95, respectively, this value was considerably ($P<0.05$) different from the other samples, RIS1 (90% rice flour and 0.81% xanthan gum), RIS2, and RIS3. Due to the gum's capacity to enhance the flavours found in the rice flour-based product, it was found that the value increased as the amount of xanthan gum decreased. This might assist enhance the flavours, that were already there or bring out new ones.

After taste

The sensory evaluations of the tortilla samples after tasting do not differ significantly ($p>0.05$). 6.15 of RIS3 is the maximum value, while the lowest value is 5.20% of RISO. With values of 5.20, 5.35, 5.35, and 6.15, respectively, it was shown that the control sample RIS0 showed an increasing tendency with decreasing xanthan gum incorporation. The results indicated that the other samples with varying amounts of xanthan gum had the same acceptable aftertaste as the control sample, RIS0.

Overall acceptability

The tortilla bread's overall acceptability received sensory ratings ranging from 6.10 to 7.10. Sample RIS0 (100% rice flour) has the lowest value, 6.10, whereas sample RIS3 has the highest value, 7.10. It was shown that when the amount of xanthan gum inclusion decreased, the value increased. The panellists' individual preferences may be the cause of this observation.

Sensory evaluation scores of shawarma samples

Table 5 shows the sensory scores of shawarma samples.

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Appearance: The range of the appearance sensory score was 6.45-7.60. The shawarma samples' sensory evaluations for appearance varied significantly ($p<0.05$). Sample RIS1, which had 90% rice flour and 0.81% xanthan gum, had the lowest score (6.45), while sample WS, which contained 100% wheat flour, had the highest score (7.60). Because of customer preferences, the values declined during the course of the samples.

Aroma: The appearance sensory score fell between 6.45 - 7.60. The sensory evaluations of the shawarma samples' appearance varied significantly ($p<0.05$). Sample WS, which had 100% wheat flour, had the greatest score (7.60), whereas sample RIS1, which contained 90% rice flour and 0.81% xanthan gum, had the lowest score (6.45). Customer preferences are the reason why the numbers dropped over the samples.

Texture: Texture's sensory score fell between 6.60 to 7.25. No significant p (>0.05) difference was found. Sample RIS1, which contains 90% rice flour and 0.81% xanthan gum, has the lowest value, 6.60, while sample RIS3, which has 50% rice flour and 0.41% xanthan gum, has the highest value, 7.25. Due to its ability to bind water and form a gel-like structure, xanthan gum improved the texture of the tortilla in comparison to the control WS, which is made entirely of wheat flour. This can enhance the elasticity and chewiness of baked goods.

Taste: Sample RIS3, which contained 50% rice flour and 0.41% xanthan gum, had the lowest sensory score of 6.90, while sample WS, which contained 100% wheat flour, had the highest score of 8.15. It was found that the value increased as the amount of xanthan gum decreased, indicating that the gum's ability to mask or reduce perceived grittiness results in a smoother and more appealing taste. The control group was significantly different ($p<0.05$) from samples RIS1, RIS3, and RIS1, with values of 7.15 and 6.90%, respectively.

Table 5: Sensory evaluation scores of shawarma samples

Shawarma Sample	Appearance	Aroma	Texture	Taste	Mouthfeel	Flavour	After taste	Overall Acceptability
WS	$7.60^{b}\pm1.19$	$7.60^{a}\pm1.10$	$7.05^{a}\pm1.10$	$8.15^{b}\pm0.88$	$7.75^{b}\pm1.02$	$7.85^{b}\pm0.99$	$7.60^{a}\pm1.05$	$8.45^{b}\pm0.67$
RIS1	$6.45^{a}\pm1.40$	$7.10^{a}\pm1.12$	$6.60^{a}\pm1.57$	$7.15^{a}\pm1.50$	$6.70^{a}\pm1.56$	$6.85^{a}\pm1.23$	$6.80^{a}\pm1.36$	$7.30^{a}\pm1.30$
RIS3	$7.00^{ab}\pm1.30$	$7.37^{a}\pm1.13$	$7.25^{a}\pm1.41$	$6.90^{a}\pm1.86$	$6.65^{a}\pm1.76$	$7.05^{ab}\pm1.67$	$6.95^{a}\pm1.32$	$7.50^{a}\pm1.43$

Mouthfeel: Sample RIS3 (50% rice flour and 0.41% xanthan gum) had the lowest sensory score (6.65), while sample WS (100% wheat flour) had the highest score (7.75). The sensory score varied from 6.65 to 7.75. With values of 6.70 and 6.65, respectively, the control was substantially different ($p<0.05$) from the other samples. This is because xanthan gum's pseudoplasticity improves the sensory qualities.

Flavour: The flavour's sensory score fell between 6.85 and 7.85. A substantial difference was observed ($p<0.05$). Sample RIS1, which had 90% rice flour and 0.81% xanthan gum, had the lowest value (6.05), while sample WS, which contained 100% wheat flour, had the highest value (7.85). Consumer preferences may be the cause of the samples' rising values.

After taste: The sensory score fell between 6.80 and 7.60. The difference was not significant ($p>0.05$). Sample RIS1, which had 90% rice flour and 0.81% xanthan gum, had the lowest value (6.80), while sample WS, which contained 100% wheat flour, had the highest value (7.60). Consumer preference was found to be the cause of the samples' declining value.

Overall acceptability: Overall acceptance has a sensory score of 7.30–8.45. WS differed considerably ($p<0.05$) from RIS1 and RIS3 samples. Sample RIS1, which had 90% rice flour and 0.81% xanthan gum, had the lowest value (7.30), whereas sample WS, which contained 100% xanthan gum, had the highest value (8.45). In contrast to the control sample, it was found that the value of xanthan gum increased; this finding can be ascribed to the panelists' individual preferences.

CONCLUSION AND RECOMMENDATION

The micronutrient composition along with organoleptic characteristics of the tortilla samples are significantly impacted when rice flour is used instead of wheat flour while making tortillas. When xanthan gum was added to rice flour, the tortilla samples' texture was better than when rice flour was used alone. With flours that don't contain gluten, which causes celiac disease and other gluten-related intolerances, this can serve as a stand-in for making gluten-free items. According to the study's findings, tortillas made with rice flour and xanthan gum had a higher micronutrient makeup. Because of this, it is advised that studies on composite flour blends be conducted in order to improve and enhance the nutritional makeup of tortillas.

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