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Original Research Article

Chemical and Functional Properties of Tortilla Produced from Rice Flour for Shawarma Production

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Abstract: The intent of this study was to assess the quality of rice flour tortillas used in shawarma preparation. Rice flour was dry milled from paddy rice, and four samples were created by varying the amount of rice flour with xanthan gum (RS0 = 100% rice flour, RS1 = 80% rice flour + 0.8% xanthan gum, RS2 = 60% rice flour + 0.6% xanthan gum, and RS3 = 40% rice flour + 0.4% xanthan gum). The functional properties of rice and wheat flours were also determined. The materials were tested for their proximate composition. The results showed that wheat flour had much better water absorption, oil absorption, and swelling capabilities, but rice flour had increased bulk density. The proximate composition results showed 2.43 to 2.85% ash, 1.00 % to 1.45 % fat, 7.82 to 9.50 crude protein and 0.93 to 78.94% crude fiber. The results likewise showed no significant difference ($p>0.05$) in the proximate composition of the tortilla samples. However, the inclusion of xanthan gum decreased moisture and carbohydrate levels.

Keywords: Rice flour; Shawarma; Functional; Chemical properties; Tortillia.

INTRODUCTION

Shawarma originated in the Ottoman Empire (Turkey) in the 18th or 19th century and was known as "cevirme," which means "turning," but the meal is now more commonly known as doner kebab, which means "turning kebab. Shawarma, according to Okafor *et al*., (2010), is a traditional Arab food made up of sliced chicken, beef, lamb, or a combination of the three, grilled on a spit and cut into small fragments, seasoned with peppers and tahini (sesame seed paste and oil), and served with vegetables and mayonnaise, usually in pita bread. Shawarma is primarily composed of two parts: the fillings, which include meats, sauces, and veggies, and the shawarma bread, also known as tortilla bread. Tortillas are thin, unleavened flatbreads made from wheat flour or lime-cooked maize (Serna-Saldivar, 2016). Maize (Zea mays L.) is one of the world's most widely produced cereal grain crops, producing food, feed, fuel, and fiber. Maize tortillas are a major source of calories and protein; nevertheless, maize proteins are of poor quality since they lack critical amino acids such as lysine and tryptophan (Reyes-Moreno *et al*., 2013). Wheat flour tortillas have recently become one of the most popular bakery items, notably in the United States and other developed countries (Barros *et al*., 2010). Fast food restaurants like wheat tortillas due to its textural properties, which include elasticity and flexibility, both of which have a significant impact on the nutritional value of wraps, tacos, and other food products (Barros *et al*., 2010). Wheat-flour tortillas have a smooth texture and a light color, which are two of the most appealing characteristics to consumers. Tortillas are usually

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made with refined and bleached wheat flour, which have 10.5 and 2.4 grams of protein and dietary fiber per 100 grams, respectively (USDA, 2017).

Furthermore, gluten is a crucial wheat component that determines the quality of bread and cakes. Gluten is the cause of celiac disease, an autoimmune intestinal illness brought on by gluten ingestion. Celiac syndrome causes a variety of problems, including absorption disorders and nutritional deficiencies, so the only way to treat it is to follow a low-gluten or gluten-free diet, as patients with this disease must avoid wheat, rye, oats, barley, and any other cereal-containing foods. Rice is a cereal that can be tolerated.

These non-wheat flours are made from other grains. The most popular ingredient is rice flour, which can be substituted for wheat flour (Cornejo and Rosell, 2015). Rice (Oryza sativa L.), which feeds half of the world's population (Amin *et al*., 2020), contains starch as its main constituent, which is regarded the most important component in most food preparations (Ashwar *et al*., 2016). As a result, the purpose of this study is to evaluate the quality of shawarma tortillas manufactured using rice flour rather than wheat or maize flour.

MATERIALS AND METHODS

Procurement of Raw Materials

Paddy rice was purchased at the Adani market in Uzouwani Local Government Area, Enugu State, Nigeria. Other ingredients were acquired from Ogige Market in Nsukka, Enugu State. Xanthan gum was acquired at a chemical store in Onitsha, Anambra State, Nigeria.

Sample Preparation

Processing of Rice Flour

Paddy raw rice was thoroughly cleaned of contaminants and steeped in water for four hours. After 4 hours, the water was changed and the rice was left to soak for another 4 hours. After that, the rice was rinsed and parboiled in boiling water for roughly 5 hours on low heat. After parboiling, the cooked paddy rice was sieved, transported to a drying mat, and sun-dried for 72 hours. The dried cooked paddy rice was dehusked to produce white polished rice, which was milled or ground into flour with a hammer mill. The rice flour was passed through a 100-mesh sieve, placed in low density polyethylene bags in a covered bucket, and stored at room temperature until use (Arendt and Zannini, 2013).

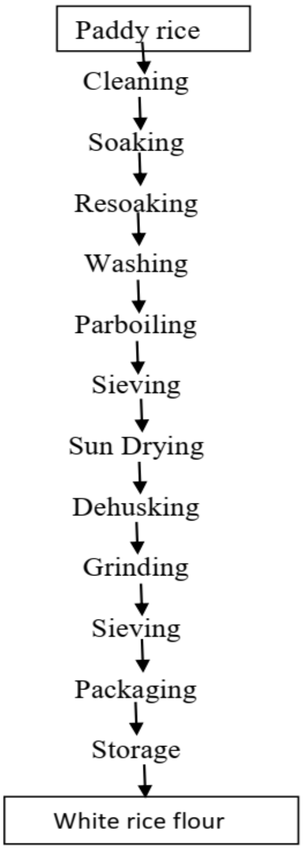

Figure 1: Shows the flow chart for processing of rice flour
Source: Arendt and Zannini, (2013)

Formulation of Rice Flour for Tortilla Production

Different ratios of rice flour (RF) and xanthan gum (XG) were used to create composite flours. The quantity of other ingredients remains consistent across the various flour mixes. Table 3 depicts various formulations of rice flour and xanthan gum for tortilla manufacture.

Ingredients for Tortilla Production

The primary ingredients for tortillas are rice flour, salt, baking powder, shortening or vegetable oil, and water. Other components, such as gums, emulsifiers, preservatives, acidulants, polyols, fiber, sugar, and whey powder, can be added as needed. Table 4 lists the elements for tortilla manufacture.

Table 1: Rice Flour for Tortilla Production

SAMPLE BLENDS	RF(g)	XG(g)
RFX	100	0
RXA	80	0.8
RXB	60	0.6
RXC	40	0.4

RF= plain rice flour, XG =xanthan gum, RFX= (100grice flour) RXA= rice flour(80g) and xanthan gum (0.8g), RXB= rice flour(60g) and xanthan gum (0.6g), RXC= rice flour(40g) and xanthan gum (0.4g).

Table 2: The recipe for tortilla production

Ingredients	Quantity (g)
Rice flour	100
Xanthan gum	variable
Salt	1g
Baking powder	0.6g
Vegetable oil	12g
Water	variable

Source: Bello *et al.,* (1991).

Tortilla Production Process

The dry ingredients were weighed. The dry ingredients were mixed for 2 minutes then add the vegetable oil and blending for 6 more minutes. Measured hot water was incorporated to the mixture and mixed for another 5 minutes, yielding a dough. The dough was allowed to rest in a bowl lined with a damp towel. After sitting for 5 minutes, the dough was split and molded into balls by hand. The dough balls were flattened with rollers and cooked for 55 seconds in a preheated fryer. Cooked tortillas were allowed to cool to room temperature for 3 minutes before being placed in polyethylene (PE) bags for analysis. Figure 2 shows the flow chart for tortilla production (Cepeda, 2000).

Determination of Functional Properties of Flours

This swelling capacity was evaluated using the method provided by Okaka and Potter (1976). The bulk density of the sample was calculated using the Okaka and Potter (1976) method. The water and oil absorption capacities of the sample were measured using the method of Ahmad *et al.*, (2015).

Proximate Analysis

Proximate analysis was assessed using the AOAC (2010).

Experimental Design and Data Analysis

The experiment will be set up in a Completely Randomized Design (CRD). The means and standard deviations of the data were computed using duplicate determinations. A One Way Analysis of Variance (ANOVA) was performed with the Statistical Package for Service Solution (SPSS version 23). Duncan's Multiple Range Test (DMRT) was used to achieve mean separation. Steel and Torrie (1980) adopted a significance level of $p<0.05$.

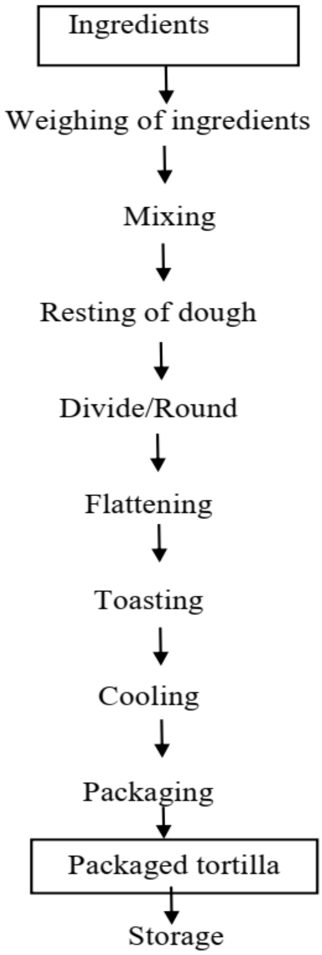

Figure 2: Tortilla Production
Source: Cepeda (2000)

RESULTS AND DISCUSSION

Pictorial Representation of Rice Flour

The pictorial presentation of rice flour as shown in plate 1.

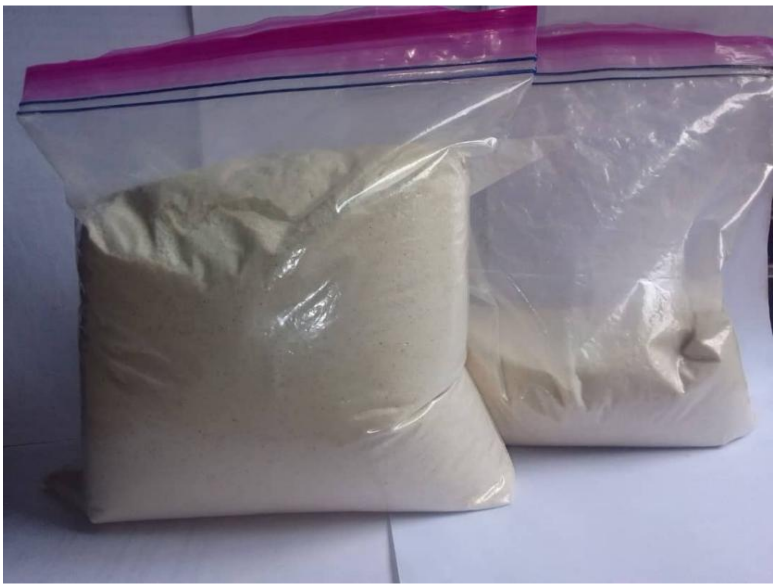

Plate 1: Rice flour

Functional Properties of Rice and Wheat Flour

The results of the functional properties of rice and wheat flour are presented in Table 3.

Bulk density

Rice flour had a significantly higher bulk density compared to wheat flour ($p<0.05$). The obtained value ranged between 0.76 and 0.86 g/cm3. Wheat flour had a lower value (0.76 g/cm3), whereas rice flour had a higher value (0.86 g/cm3. The bulk density values are consistent with Emojorho and Okonkwo's (2022) report for orange seed flour, ranging from 0.38 to 0.88 g/cm3. Rice flour has a higher bulk density due to its small and compact starch granules. These compact granules contribute to a tighter packing arrangement, resulting in a higher bulk density. Wheat flour, on the other hand, contains larger, more irregularly shaped starch granules, allowing for loose packing and lower density. Bulk density shows a food product's porosity, which influences package design and can help decide the sort of packaging material needed (Iwe *et al*., 2016).

Swelling capacity (SC)

The swelling capacity test revealed that wheat flour had a larger swelling capacity than rice flour. The values obtained ranged from 41.45 to 51.43%. Rice flour had a lower value (41.45%), whereas wheat flour had a higher value (51.43%). Wheat flour has much larger swelling capacity than rice flour, which can be related to differences in protein and starch content. Wheat flour contains two primary proteins: gliadin and glutenin, which when hydrated create a complex network known as gluten. Gluten has a unique viscoelastic feature that enables it to stretch and retain water inside its structure, resulting in greater swelling capacity. Rice flour, on the other hand, does not include gluten and is mostly made up of starch granules that have limited swelling ability when hydrated. The starch granules collect water on their surface but do not form the same extensive network as gluten. Flour with a high swelling capacity has the ability to grow in volume when used in products like bread and biscuits. It can also act as a food thickener in liquid and semi-liquid goods (Osundahumsi *et al.*, 2003).

Table 3: Functional properties of flour from wheat flour and rice flour

Flour sample	Bulk density (g/cm^3)	Swelling capacity (%)	Water absorption capacity (%)	Oil absorption capacity (%)
RF	0.86±0.01	41.45±1.43	330.38±13.97	205.78±7.05
WF	0.76±0.01	51.43±0.00	345.83±49.32	240.22±0.02

Values are means of duplicate determinations ± standard deviation.
KEY: RF = 100% Rice flour; WF= 100% wheat flour.

Water Absorption Capacity (WAC)

The water absorption capacity test findings revealed that wheat flour has a greater water absorption capacity than rice flour. The flour's water absorption capacity ranged between 330.38 and 345.83 percent. Rice flour had a low value of 330.38%, but wheat flour had a high value of 345.83%. Wheat flour includes gluten, a protein that forms a network when combined with water, giving dough structure and elasticity. As a result, the gluten network has the ability to store water, which improves water absorption capacity. The water absorption capacity of flour reflects its consistency and suitability for the production of a variety of culinary products, including dough, sausage, processed cheese, and bread (Maudu *et al*., 2021).

Oil Absorption Capacity (OAC)

The oil absorption capacity test revealed that wheat flour had a higher oil absorption capability than rice flour. The OAC of the flour ranged between 205.78 and 240.22%. Rice flour has a lower value (205.78%) than wheat flour (240.22%). OAC is higher in wheat flour because it contains more lipids (fats). When oil is added to wheat flour, it interacts with the lipids present, and the gluten protein forms a network that traps oil within the dough. Rice flour, on the other hand, is gluten-free and has less fat. As a result, it absorbs and binds with oil less effectively. The flours' ability to bind with oil indicates their usefulness in food applications where optimal oil absorption is desired, making them potentially functional in foods such as pastries, sausage, whipped toppings, chiffon desert, and others, as well as aiding in flavor retention (Suresh and Samsher, 2013).

Proximate Composition of Tortilla Samples Produced from Rice Flour

The proximate makeup of the tortilla samples is reported in Table 4. There was no significant variation in moisture content ($p>0.05$) between the tortilla samples. The moisture level ranged from the lowest of 8.40% in the RS3 sample, which contained 40% rice flour and 0.4% xanthan gum, to the highest of 8.82% in the RS0, which contained 100% rice flour. RS1 and RS2 have 8.75% and 8.57%, respectively. Incorporating less xanthan gum resulted in a loss in value. This is because xanthan gum has an excellent water holding capacity even at low concentrations, and it can absorb and retain significant amounts of moisture, preventing it from becoming available to other ingredients, potentially resulting in a decrease in the overall moisture content of rice flour. The moisture content falls below the 10% moisture content limit for foods. This suggests that the product will remain shelf stable (Mbatchou and Dawda, 2013).

The ash levels of the tortilla samples varied between 2.43 and 2.85%. There were no significant differences between the samples (p>0.05). The ash level was lowest in sample RS3, which contained 40% rice flour and 0.4% xanthan gum, with a value of 2.43%, and highest in sample RS1, which contained 80% rice flour and 0.8% xanthan gum, with a value of 2.85%. Emojorho *et al.*, (2023) reported 3.82 to 5.30% ash for orange seed flour biscuits, however our results were lower. Aside from the control RS0 (100% rice flour) with a value of 2.50%, the addition of xanthan gum caused a constant increase in the ash content of samples. The values are 2.85%, 2.70%, and 2.43%, respectively. The ash content is a measure of the inorganic residue left after the water and organic stuff have been removed by heating.Ash is useful in determining the mineral element composition of food samples (Mbatchou and Dawda, 2013).

The fat percentage in the tortilla samples vary from 1.00 to 1.45%. There were no significant differences among the samples (p > 0.05). The fat content of the tortilla samples ranges from 1.00% in sample RS0 (100 percent rice flour) to 1.45% in sample RS3, composed of 40% rice flour and 0.4% xanthan gum. The addition of xanthan gum led to a rise in value. This conclusion contradicts the findings of Suraiya *et al.*, (2016). In a comparative study of the proximate compositions and functional properties of various Pakistani rice flour varieties, they discovered a drop in fat content that varied from 0.43% to 1.5%. The differences in the research could be attributed to varied climate conditions, environmental factors, and processing and milling techniques.

Table 4: Proximate composition (%) of tortilla bread samples produced from rice flour

Tortilla Samples	Moisture	Ash	Fat	Protein	Fibre	Carbohydrate
RSO	8.82^a±0.26	2.50^a±0.71	1.00^a±0.00	7.82^a±1.15	0.93^a±0.10	78.94^a±0.08
RS1	8.75^a±1.06	2.85^a±0.50	1.35^a±0.21	8.50^a±0.71	1.10^a±0.14	77.45^a±1.20
RS2	8.57^a±1.32	2.70^a±0.42	1.35^a±0,42	9.00^a±0.71	1.30^a±0.99	77.13^a±2.16
RS3	8.40^a±1.41	2.43^a±0.81	1.45^a±0.07	9.50^a±0.70	1.40^a±0.0	76.22^a±0.03

Values are means of duplicate determinations ±standard deviation. Means with different superscript in the same column are significantly (p<0.05) different.

Key: RSO= tortilla bread from100% rice flour; RS1= tortilla bread from 80% rice flour + 0.8% xanthan gum; RS2= tortilla bread from 60% rice flour + 0.6% xanthan gum; RS3= tortilla bread 8from 40% rice flour + 0.4% xanthan gum

The protein percentage of the samples ranged between 7.82 and 9.50%. The protein content percentages vary from 7.82% in sample RS0, which contains 100% rice flour, to 9.50% in sample RS3, which contains 40% rice flour and 0.4% xanthan gum. The addition of xanthan gum resulted in an increase in protein content from the control RS0, RS1, RS2, and RS3, with values of 7.82%, 8.50%, 9.00%, and 9.50%, respectively. However, no significant difference (p<0.05) was seen among the tortilla samples. These results are within the range reported by Suraiya *et al.*, (2016), but lower than the 14.8 to 19.24 stated by Emojorho *et al*., (2023) for biscuits produced from composite flour. These findings are consistent with the values published by Suraiya *et al.*, (2016). In a research of comparative investigations on flour proximate compositions and functional qualities of selected Pakistani rice flour types, they found an increase in protein content ranging from 8.13% to 9.77%. There was no significant difference between the tortilla samples in terms of crude fiber (p>0.05). The crude fibre percentage of the samples ranged between 0.93 and 1.4%. Sample RS0 (100% rice flour) had the lowest fiber level (0.93%), while sample RS3 (40% rice flour and 0.4% xanthan gum) had the greatest fibre content (1.40%). Anene *et al.*, (2023) reported a crude fiber content of 0.23 to 0.84% in Idli made with composite flour. This corresponded to the mean values found by Samuel *et al*., (2019) for the nutritional composition and heavy metal profile of Nigerian rice cultivars in flour. This can be ascribed to the milling process, which decreases the fiber content of rice flour.

The carbohydrate content of the samples varied from 76.22 to 78.94%. There were no significant differences (p>0.05) between the samples. The smallest value was noticed in sample RS3 (40% rice flour and 0.4% xanthan gum) with score of 76.22% while the largest value was observed in sample RS0 (100% rice flour). It was found that the carbohydrate contents declined with reduced xanthan gum incorporation. This is as an outcome of the xanthan gum having ability to bind the rice as well as starch components together, with a drop in xanthan gum, the ability may decline resulting to a potential loss of carbohydrate during cooking. These findings are in agreement with the results reported by Samuel *et al*., (2019) on the nutritional composition and heavy metal profile of Nigerian rice types in flour. This can be due to the milling process, which produces a decrease in the fiber content of rice flour.

Pictorial presentation of Shawarma Samples from wheat and Rice Tortilla Bread

Plate 2, 3, 4 are pictorial presentation of shawarma samples produced from tortilla wheat bread and tortilla rice bread are shown below.

Plate 2: RS0

Plate 3: RS1

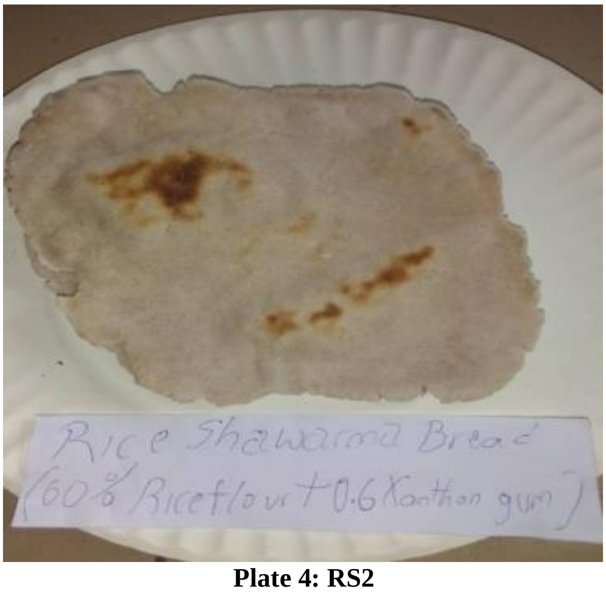

Plate 4: RS2

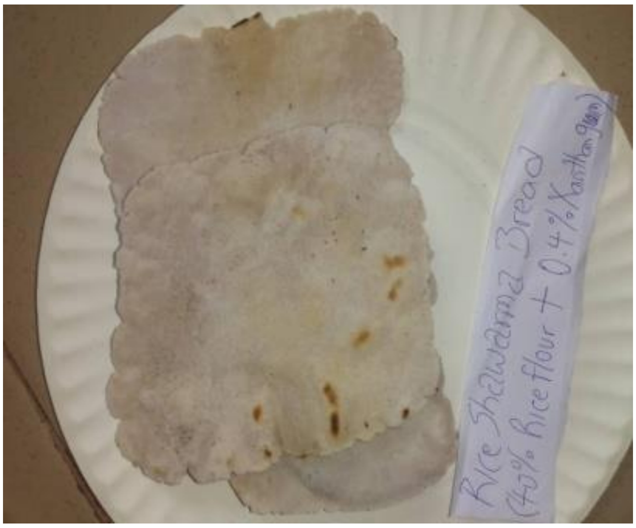

Plate 5: RS3

Key: RS0 (100% rice flour), RS1 (80% rice flour and 0.8% xanthan gum), RS2 (60% rice flour and 0.6% xanthan gum), RS3 (40% rice flour and 0.4% xanthan gum), WS (100% wheat flour shawarma bread).

CONCLUSION

The substitution of wheat flour for rice flour in tortilla production has a significant impact on the functional and chemical properties of the samples. The functional features revealed that wheat flour had much better swelling capacity, water absorption capacity, and oil absorption capacity than rice flour, whereas rice flour had a greater bulk density. The addition of xanthan gum to the chemical composition resulted in a drop in moisture content, boosting the tortilla's shelf durability. This can be used to make gluten-free items using flours that do not contain gluten, which causes celiac disease and other gluten-related sensitivities. Based on the findings of this study, tortillas made from rice flour and xanthan gum had a better nutritious content. As a result, it is advised that research be conducted on composite flour blends for tortilla production in order to improve and boost the nutritious composition of the tortilla. In addition, research should be conducted on tortilla packing materials in order to lengthen the product's shelf life.

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