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NUTRITIONAL VALUE OF CHAPATI PRODUCED FROM THREE WHEAT VARIETIES

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ABSTRACT

Flat breads predate pan bread and its spread is universal. Chapati is the oldest and most consumed flat bread in the world which contributes to a substantial amount of dietary energy intake. The objective of this study is to determine the nutritional value of Chapati prepared from three improved varieties of wheat Atila Gan Atila, Cetia and Seri M82 produced in Maiduguri, Borno State, Nigeria. Chapatis were prepared from three varieties of wheat Atila Gan Atila, Cetia and Seri M82.Proximate composition, mineral element composition, antinutrients, in vitro carbohydrate and in vitro carbohydrate digestibilities were determined using standard laboratory procedures. All determinations were carried out in triplicates. Data obtained from the research were analysed using Analysis of Variance (ANOVA). Duncan multiple range test was used to compare the differences between the means using SPSS 11.0 software. Significance was accepted at $p \leq 0.05$. The results showed that the chapati prepared from Atila Gan Atila had significantly $P \leq 0.05$ higher protein (9.48±0.03%) and fiber (5.74±0.15%) contents and a significantly $P \leq 0.05$ lower metabolisable energy (347.36±0.07%) while the chapati prepared from Seri M82 had the lowest protein (7.76±0.14%) and fiber (4.56±0.03%) contents and a significantly $P \leq 0.05$ higher metabolisable energy (357.22±0.33%). All the three chapatis showed significant $P \leq 0.05$ reduction in the level of antinutrients: phytic acid and tannins. Significant $P \leq 0.05$increases in *in vitro* protein digestibilities and *in vitro* carbohydrate digestibilities were exhibited by the chapatis. Chapati prepared from the three wheat varieties did not show any significant $P > 0.05$ difference in the levels of iron, magnesium and calcium while Atila Gan Atila chapatti exhibited the highest level of phosphorus (481.33±0.11%). The results of the sensory evaluation showed that the chapati prepared from Atila Gan Atila (7.8 ± 0.75%) was preferred followed by that produced from Cetia (5.5 ± 0.99) and Seri M82 (5.5 ± 1.34). In conclusion, the results showed that the result showed that the chapati prepared from Atila Gan Atila is superior to that prepared from Cetia and Seri M82.

KEYWORDS: Chapati, Protein, Carbohydrate, Digestibility, Antinutrients.

INTRODUCTION

Wheat is the most important cereal crop in the world and ubiquitous in the food culture of North America and many other regions of the world. It is a type of grass grown for its highly nutritious and useful grain. In its natural unrefined state features a host of important nutrients.[1]

Flat breads predate pan bread and its spread is universal. Chapati is the oldest and most consumed flat bread in the world which contributes to a substantial amount of dietary energy intake.[1,2] Chapati is the staple flat bread of Northern India and Pakistan also known as Roti. It can be made from many types of grain but is most commonly made with finely ground whole wheat flour. Sometimes, it is cooked in a little oil. Chapatis are usually eaten with cooked Dal (lentil soup) or vegetable dish like Indian curry. It's a bread that is really easy to make and a perfect accompaniment for baby's homemade curries.[3]

This present study is aimed to determine the nutritional value of Chapati produced from three different improved varieties of wheat in Borno State, Nigeria.

MATERIALS AND METHODS

Materials

Three improved wheat varieties were used for this study. The three varieties were obtained from Lake Chad Research Institute (LCRI) Maiduguri, Borno State, Nigeria and they include Atilla Gan-Atilla, Cetia and Ceri M82.

Preparation of raw material

The three wheat varieties (Atilla Gan-Atilla, Cetia and Seri M82) were cleaned of dirt, washed and dried to a constant weight. The dried whole wheat was milled and sieved using a 2mm sieve pore to obtain fine uniform particle size. The flour obtained were used for the preparation of chapati.

Preparation of chapatis

Chapatis were prepared by following the method as reported by previous researchers.[4,5] with slight modifications. The chapati dough was prepared by mixing whole wheat flour with the pre-determined optimum amount of water and salt (1.5%). The dough was covered with a wet cloth and was set aside to rest for 30 minutes at room temperature (25± 1^{o}C). The dough was divided into equal portions and rolled into a round sheet (12 cm in diameter and about 2 mm in thickness). The chapatis were baked on a pan at 210 ^{o}C for 150 seconds on each side. After baking, chapatis were cooled on a wire rack at room temperature before packing in sealed pouche.

Proximate composition

Proximate compositions of the chapati from the three wheat varieties were determined by the standard methods of AOAC.[6]

Determination of soluble carbohydrate (Nitrogen-free extract, NFE)

The carbohydrate (NFE) content of the samples was determined by difference.[7] according to this formula:
% carbohydrate (NFE) = 100 – (% moisture + % ash + % protein + % fat + % crude fibre).

Determination of Metabolisable Energy

The matabolisable energy was calculated by the Atwater conversion factors.[8]
1 g of carbohydrate = 4Kcal.
1 g of fat = 9 Kcal.
1 g of protein = 4 Kcal.

Determination of Mineral Elements

Atomic absorption Spectrophotometer (AAS) AA series (6800 series Shimazo Corp) was used for determination of Ca, P, K, Na, Fe, Zn and Mg.

Determination of antinutrients

Tannin content determination

Tannin content of the raw and processed Pearl Millet and wheat were determined by the method described by Price and Butler (9). 0.2 g of sample was weighed into Erlenmeyer flask, and 10 ml of 4% HCl in methanol was pippeted into the flask. The flask was closed with parapilus and shaken for 20 minutes on a wrist actron shaker. One millilitre (1ml) of extract was pippeted and 1 ml of 1% vanillin and 0.5 ml of conc. HCl was added.

Five test tubes were labelled I, II, III, IV and V to prepare the standard solutions. Into the five test tubes, 0.1, 0.3, 0.5, 0.7 and 1, 0 ml of phenol reagent was added respectively. The test tubes were made up to 1ml with methanol (8% HCl in methanol); 1.0 ml of 1% vanillin and 0.5 ml conc. HCl was added to the tubes and made up to 5.5ml with 4% HCl in methanol. Blank sample was prepared by using 5 ml of 4% HCl in methanol. The absorbance of the standard solutions, sample extract and blank sample were read using a spectrophotometer at 500nm 20 minutes after incubation.

Calculation

$$\frac{Au}{Cu} = \frac{Astd}{Cstd}$$

$$Cu = \frac{Au}{Astd} \times Cstd = mg/g$$

Where
Au = Absorbance of unknown.
Astd =Absorbance of standard.
Cu = Concentration of unknown.
Cstd = Concentration of standard.

Determination of phytic Acid

Phytic acid content of the raw and processed Pearl Millet and wheat samples were determined according to the method described by Davies and Reid.[10] One gramme (1g) of sample was extracted by taking 40 ml of 0.5M Nitric acid in a conical flask and shaken for one (1) hour on a shaker at 30^{O}C and 80 revolutions per minute. The samples were filtered and 5 ml of 0.08M Ferric chloride was added and boiled for 20 minutes and filtered. The free iron (Fe^{3-}) remaining in the solution was determined colorimetrically by adding 2 ml of 0.005M ammonium thiocynate and the iron-binding capacities of the extract was determined by difference.

Determination of *in vitro* carbohydrate digestibility

The method of Shekib *et al*.[11] was used. Into four sets of test tubes labelled I, II, III and IV (0,30, 60 minutes and 6 hours),1ml of α-amylase, 4 ml of phosphate buffer and 1ml of sodium chloride was added and allowed to equilibrate at room temperature. After equilibrium, 5 ml of 1% sample was added and mixed thoroughly. At intervals of 10,30 and 60 minutes, 3 drops of Lugol's iodine was introduced into the reaction mixture and absorbance of starch-iodine complex measured colorimetrically at 620nm with Corning colorimeter 253 alongside the blank (Lugol's iodine). Unit of amylase activity was calculated as:

$$\frac{Ao - At \times 100}{Ao}$$

Where
Ao = Absorbance of iodine-starch complex at zero time.
At = Absorbance of iodine-starch at specified time intervals.

Specific activity of amylase is expressed in unit /mg protein/minute.

Determination of *in vitro* protein digestibility

The *in vitro* protein digestibility of the samples was determined according to the method described by Nills.[12] One millilitre (1ml) of 11% trypsin was introduced into 3 test tubes, 4 ml of phosphate buffer at pH7.5 was added into each test tube and 1ml of 1% sample was added to all the test tubes (labelled as digestibility at 0 hour, 1 hour and 6 hours).The reaction in each test tube was stopped with 5 ml of neutralised formalin at 1 hour and 6 hours. The content of the test tubes were filtered using filter papers. The filter papers were dried in an oven at 180^{O}C for 3 hours. The nitrogen content of the undigested sample was determined by Kjedahl method.

$$\text{\% in vitro protein digestibility} = \frac{CP_1 - CP_2}{CP_1} \times 100$$

Where
CP_1 = Total protein of unprocessed grain.
CP_2 = Total protein after digestion with trypsin.

Sensory evaluation

Chapati from the three wheat varieties were prepared and evaluated by 50(semi trained) students using a nine-point hedonic scale as described by Land and Shepard.[13] The mean scores were analysed by Duncan's multiple range test.

Statistical analysis

Data obtained from the research were analysed using Analysis of Variance (ANOVA). Duncan multiple range test was used to compare the differences between the means using SPSS 11.0 software. Significance was accepted at $p \leq 0.05$.

RESULTS

The result of the proximate composition of chapati produced from three wheat varieties is presented in table 1. Significant ($P < 0.05$) differences were obtained in the levels of protein, soluble carbohydrate and metabolisable energy of chapatti produced from Atilla-Gan-Atilla, Cetia and Seri-M82 while no significant($P > 0.05$) differences were observed in the ash and fat contents of the three chapatis. Chapati produced from Atilla-Gan-Atilla had the highest protein content (9.48±0.03) and fiber (5.74±0.15). Chapati produced from Seri M82 had the highest soluble carbohydrate (78.35±0.05) and metabolisable energy (357.22±0.33). All the three chapatis exhibited low moisture contents.

The result of the mineral element composition of chapati produced from three wheat varieties is presented in table 2. Significant ($P<0.05$) differences were observed in the level of phosphorus of the three chapatis while no significant (P 0.05>) differences were observed in the levels of iron, magnesium and calcium of the three chapatis.

Table 1: Proximate composition of chapati produced from three wheat varieties.

Parameters	Atilla Gan Atila	Cetia	Seri M82
Moisture (%)	7.74±0.18^{a}	6.14±0.11^{b}	6.31 ±0.11^{b}
Ash (%)	1.43 ±0.26^{a}	1.50±0.07^{a}	1.60±0.18^{a}
Protein (%)	9.48±0.03a	8.92±0.10b	7.76±0.14c
Fat (%)	1.40±0.08^{a}	1.31 ±0.06^{a}	1.42±0.10^{a}
Fiber (%)	5.74±0.15^{a}	4.76±0.35^{b}	4.56±0.03^{b}
Soluble Carbohydrate (%)	74.21 ±0.33^{a}	77.37±0.15^{b}	78.35±0.05^{c}
Metabolisable energy (kcal)	347.36±0.07^{a}	356.95±0.03^{b}	357.22±0.33^{c}

Values are recorded as mean ± SD of three determinations. Means in the same row with different superscripts are significantly different ($P \leq 0.05$).

Table 2: Mineral element composition of chapati produced from three wheat varieties.

Nutrients	AtiIla-Gan-Atilla	Cetia	Seri M82
Iron	4.53±0.01^{a}	4.74±0.01^{a}	4.02±0.01^{a}
Magnesium	175.28±0.01^{a}	175.53±0.01^{a}	175.89±0.01^{a}
Phosphorous	481.33±0.11^{a}	471.47±0.23^{b}	465.98±0.21^{c}
Calcium	37.28±0.01^{a}	37.29±0.01^{a}	37.18±0.01^{a}

Values are recorded as mean ± SD of three determinations. Means in the same row with different superscripts are significantly different ($P \leq 0.05$).

The Antinutrient Factor content of the three wheat varieties is presented in table 3. A reduction in the level of phytic acid was exhibited by the three wheat varieties. Atilla-Gan-Atilla had the highest percentage decrease (50%) closely followed by Seri-M82 (48.07 %) and Cetia (42.27%). The highest percentage decrease in tannins was recorded in Seri M82 (48.54 %) while the lowest was in Atilla Gan Atilla (45.09 %).

The results of the *in vitro* protein digestibility is presented in table 4. The lowest digestibility at one(1) hour was recorded with the chapati prepared from cetia (44.27+0.03) while the highest was Atilla Gan Atilla (43+0.44). The chapati produced from cetia showed the highest *in vitro* protein digestibility (89.05+0.09%) at six hours. The *in vitro* carbohydrate digestibility of the chapati prepared from the three wheat varieties is presented in table 5. The chapati prepared from Atilla Gan Atilla had the lowest digestibility at 30 minutes while cetia had the highest digestibility at six(6) hours

Table 3: Antinutritional factor content of chapati produced from three varieties of wheat.

Antinutrients	Atila Gan Atila		Cetia		SeriM82	
	Raw	Chapati	Raw	Chapati	Raw	Chapati
Phytic acid (mg/g)	0.54 ± 0.52^a	0.27 ± 0.20^b	0.55 ± 0.60^a	0.29 ± 0.10^c	0.52 ± 0.31^a	0.27 ± 0.01^b
Percentage decrease	50.00		47.27		48.07	
Tannin (mg/g)	2.75 ± 0.20^a	1.51 ± 0.33^b	2.36 ± 0.45^a	1.29 ± 0.13^b	2.74 ± 0.07^a	1.41 ± 0.05^b
Percentage decrease	45.09		45.33		48.54	

Values are recorded as mean ± SD of three determinations. Means in the same row with different superscripts are significantly different (P≤0.05).

Table 4: *In vitro* protein digestibility of chapati produced from three varieties of wheat.

Digestibility	Atila Gan Atila	Cetia	SeriM82
Digestibility at one (1) hour	47.43 ± 0.44^a	44.27 ± 0.03^b	45.25 ± 0.04^b
Digestibility at six (6) hours	87.52 ± 0.28^a	89.05 ± 0.09^b	85.25 ± 0.06^c

Values are recorded as mean ± SD of three determinations. Means in the same row with different superscripts are significantly different (P≤0.05).

Table 5: *In vitro* carbohydrate digestibility of chapati produced from three varieties of wheat.

Digestibility	Atila Gan Atila	Cetia	SeriM82
Digestibility at 30 mins (%)	14.96 ± 0.78^a	15.34 ± 0.65^b	16.12 ± 0.21^c
Digestibility at 60 mins (%)	30.32 ± 0.13^a	33.27 ± 0.14^b	32.13 ± 0.08^c
Digestibility at 6 h (%)	85.17 ± 0.06^a	88.13 ± 0.07^b	87.45 ± 0.12^c

Values are recorded as mean ± SD of three determinations. Means in the same row with different superscripts are significantly different (P≤0.05).

The result of the sensory evaluation is presented in table 6. In terms of taste and texture, all the three chapatis prepared from the three wheat varieties did not show any significant (P>0.05) difference. In the overall acceptability, the chapati produced from Atilla Gan Atilla was rated higher (7.8 ± 0.75) than Cetia (5.5 ± 0.99) and Seri M82 (5.5 ± 1.34).

Table 6: Sensory evaluation of chapati produced from three varieties of wheat.

	Taste	Texture	Overall Acceptability
Atila Gan Atila	6.6 ± 1.20^a	5.7 ± 0.88^b	7.8 ± 0.75a
Cetia	6.3 ± 1.29^a	5.7 ± 1.04^b	5.5 ± 0.99^b
Seri M82	6.0 ± 1.69^a	5.7 ± 0.77^b	5.5 ± 1.34^b

Based on a nine-point hedonic scale Values are recorded as mean ± SD of 50 determinations. Means in the same row with different superscripts are significantly different (P≤0.05)

DISCUSION

The decrease in the moisture content exhibited by all the Chapatis produced from the three varieties of wheat shows that it will have a good storage quality. A decrease in moisture content reduces the possibility of food spoilage by microorganisms.[14] The protein content of the three chapatis ranged between 9.48±0.03 and 7.76±0.14 with Atilla Gan Atilla having the highest value. The protein content of Atilla Gan Atilla is within the range of the protein content (9-10.5 %) of wheat flour obtained from medium-hard aestivum wheat with quality characteristic suitable for making chapatti.[15] whole wheat flour is obtained when the entire wheat kernel is ground and the extraction rate is 100% because all of the wheat is recovered as flour.[16] It is desirable to grind wheat to a fine particle size and it is a normal practice to sieve which removes 3-5% of coarse bran from whole wheat flour which might lead to slight reduction in the ash, fiber, protein and carbohydrate content of the wheat flour.[14] Most of the fiber present in whole wheat is insoluble fiber (they do not dissolve in water.) which is composed of chains of glucose linked in B-1,4 bonds.[17] These bonds are not broken down by the human digestive enzymes. These undigested fibers pass through the small intestine into the large intestine where bacteria metabolise some and form short-chain fatty acid and gas. These short chain fatty acids provide fuel for cells in the large intestine and enhance intestinal health.Insoluble fibers include cellulose, hemicellulose and lignin. Cellulose is found in the outer skins while lignin and hemicellulose are found in the outer bran layers of whole grains.[18] The fiber content of the three chapatis ranged between 5.74±0.15 and 4.56±0.03 with Atilla Gan Atilla having the highest value. These values are consistent with the report of Rao *et al.*[15]

There were no significant differences in the levels of iron, magnesium and calcium of the chapatis produced from the three varieties of wheat but significant difference was observed in the level of phosphorus with Atilla Gan Atilla having the highest value. The levels of Iron, magnesium, phosphorus and calcium were higher than the values reported by Atwel and Finnie.[16]

Antinutrients factors are plant-based compounds which interfere with the absorption of nutrients. The major antinutrients found in grains are phytates and tannins. The nutritional value of foods strongly depends on the nutritional and antinutritional composition therefore reduction in the level of antinutrients improves the nutritional value of foods.[19]

Processing of the sample showed an apparent reduction in the phytate content. Exposing the wheat to heat (roasting of the chapati) remove a greater percentage of anti-nutrients (Phytate). The high level of tannins in the unprocessed wheat varieties may be due to the presence of the coloured pericap which can be brown or red respectively.[20] All The chapatis produced from the three varieties of wheat exhibited increase in digestibility with increase in time. The increase in the digestibilities could be attributed to the reduction of the levels of antinutrients.

In terms of taste and texture all the three chapatis were rate equal but in the overall acceptability, the chapati prepared from Atilla Gan Atilla was rated higher than Cetia and Seri M82.

CONCLUSION

Chapatis were prepared from three improved varieties of wheat from Maiduguri, Borno state Nigeria to see which one of the chapatis will have a higher nutritional value. From the results obtained in this study, the chapati prepared from Atilla Gan Atilla had the highest nutritional value than the chapati prepared from Cetia and sei M82. Fortification of Chapati with legumes will further enhance its nutritional value.

REFERENCES

1. Wani, A; Sog, DS; Sharma, P and Singh, B Phytochemical and Pasting properties of unleavened white flour bread (chapatti) as affected by addition of pulse flour. *Cogent Food and Agriculture*, 2016; 2(1): 20.
2. Agbara, Gervase Ikechukwu; Bade Aminu; Ali Sadiya Halima; Adams Mustapha Fanna. Evaluation of production, consumption and nutritive value of gurasa, an indigenous flat bread of Noerthern-Western Nigeria. *International Journal of Scientific Research and Management,* 2018.
3. Anderson, J.W., Hana, T.J., Peng, X. and Kryscio, RJ. *Whole grain foods and heart disease rise.* Academic press, 2000; 2915-2950.
4. Rao, M. and Bharati, P. Dough characteristics and chapathi making quality of wheat varieties. *Karnataka Journal of Agricultural Science*, 1996; 9: 562-564.
5. Kadam, M. L., Salve, R. V., M. M. and More, S. G. Development and evaluation of composite flour for Missi roti/ chapatti. *Journal of Food Processing and Technology*, 2012; 3(1): 134-140.
6. AOAC. Association of Official Analytical Chemists *Official Methods of Analysis.* 18th edition. Washington D.C. USA., 2005.
7. Egan, H., Kirk, K.R and Wayer, R. *Pearson's Chemical Analysis of Food*. (8th ed) Church hill livingstone Edinburgh: London, New York, 1981; 233.
8. Food and Agriculture Organization Wheat Flour: Agric Handbook. Food and Agriculture Organization of the United States, 2011; 12 -18.
9. Price, P.L.M. and Butler, L.G. Rapid visual estimation and spectrotometric determination of tannin content of sorghum grains. *Journal of Agriculture and Food Chemistry*, 1977; 25: 1268-1273.
10. Davies, N.T and Reid, H. An evaluation of phytate zinc availability from soya based texture-vegetable protein meet substitute or meet extenders. *British Journal of Nutrition,* 1979; 41: 579.
11. Shekib A.I., Samir, M.E. and Abobakar, M.T. Studies on amylase inhibitors in some Egyptian legumes seeds. *Plant Foods for Human Nutrition*, 1988; 38: 325-352.
12. Nills, B.B. *In vitro* digestibility of bakery and other cereals. *Journal of Food Science,* 1979; 30: 583-589.
13. Land, D.G. and Shephard, R. Scaling and ranking methods. In Piggott. J.R. (Ed). *Sensory Analysis of foods*. Elsevier Applied Science, London, 1988; 155-185.
14. Ijarotimi, O.S. and Keshinro, O.O. Determination of nutrient composition and protein quality of potential complementary foods formulated from combination of fermented popcorn, Africa locust beans and bambara groundnut seed flour. *Journal of Food and Nutrition Science*, 2013; 63(3): 155-166.

15. P.Haridas Rao, and R.Sai Manohar *Chapatis and Related Products*. Encyclopedia of Food Sciences (second Edition), 2003.
16. William Atwel and Sean Finnie *Milling* (chapter 2) In Wheat Flour (second edition) American Association of Cereal Chemists International AACC International, Inc. published by Elsevier. Pp 17-30 https://doi.org/10.1016/B978-1-891127-90-8.50002-4 (accesed 27th January, 2020), 2016.
17. M.Ann Bock and Nancy Flores *Nutrition information related to battered and breaded food products.* Batters and breadings in food processing. (second edition) American Association of Cereal Chemists International(AACC) International, Inc. Elsevier publishers, 2011; 153-168. https://doi.org.10.1016/B978-1-891127-71-750014-0(accessed 27th January 2020).
18. Bryrd-Brdbenner, C., Moe, G., Beshytoor, D. and Berning, J. *Wordlaws Perspective in Nutrition* (8th Ed.) McGraw Hill International, New York, 2009; 159-169.
19. Aneta Popova and Dash Mihaylova Antinutrients in plants: A review. *The open Biotechnology Journal*, 13(69): 1-9 https://openbiotechnologyjournal.com (accessed 26th January 2020), 2019.
20. Qin Liu. Comparison of Antioxidant activities of different colored wheat grains and analysis of phenolic of compound. *Journal of agricultural and food Chemistry*, 2010; 58(16): 9235 - 9241.