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Evaluation of Phytonutrient and Proximate Composition Profiles of Cereal-Based *Tuwo* Commonly Consumed in Matsango-Azare, Katagum Local Government Area of Bauchi State

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ABSTRACT

Cereal-based foods, particularly Tuwo, are among the the most consumed dishes not only in the Hausa/Fulani community of Matsango-Azare Katagum Local Government area of Bauchi State but the whole of sub-saharan Africa where these ethnic groups are the dominance. Anti-nutritional profiles and proximate composition of the tuwo from maize, millet, rice and guinea-corn consumed in this locality have been evaluated. Proximate composition ranged as follows, moisture 58.3940-68.3760%, ash 0.8320-0.3000%, fat 1.7950-3.1100%, protein 6.0170-10.9400%, carbohydrate 20.3600-33.4320%, crude fiber 0.4960-1.0695%. Phytochemical composition of the tuwo collected also ranged as follows, alkaloid 0.6830-2.7270mg/100g, flavonoid 0.8650-3.0620mg/100g, terpenoids 0.4005-1.1170mg/100g, glycosides 0.5160-1.5025mg/100g, steroids 0.9040-2.0670mg/100g, tannins 2.2000-5.2545mg/100g, saponins 1.1575-5.0320mg/100g. The study provided important data on the most consumed of the tuwo types in the locality and their nutrients and anti-nutrient profiles were analyzed as stated. A campaign was set up which geared on improving the nutritional status of the people in this study area. It is recommended that the tuwo from single cereal-based flours require value addition with a legume which will improve the nutrient profiles and methods such as soaking, de-hulling need to be emphasized to these inhabitants as they help to reduce the extent of these phyto-chemicals.

Keywords: phytonutrient, tuwo, cereal-based foods, porridge, proximate composition

INTRODUCTION

Tuwo is a local food of the Hausa/Fulani tribe and is most commonly in the whole of Northern Nigeria. Cereals are major staple foods in Nigeria, and are rich sources of nutrients especially when used as whole grains Joseph et al. (2021). Cereals such as pearl millet [(Pennisetum glaucum (L)], finger millet (Eleusine coracana), and sorghum (Sorghum bicolor (L) Moench) widely grown by small holder farmers mainly in marginal rainfall regions. The production trends of small grains and has been increasing by approximately 14% and 40% at World and Africa levels, respectively, over the years (USDA, 2016).

Cereal grains cultivation and processing are as old as man. The adoption of a given grain for fodder, feed and food is determined by prevailing climatic conditions of a region. North-Eastern Nigeria dwells suitably in Sudan sahelian zone, a semiarid environment suited for cultivation of such cereals as pearl millet, grain sorghum and others. The

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nutritional wellbeing of the inhabitants of this zone rest squarely on consumption of cereal based traditional foods notably tuwo a thick porridge either prepared from any of the dominant grain, a staple that is consumed any time of the day with traditional soups and sauces.

During processing to obtain flour, several authors including Hotz and Gibson (2007), have reported the loss of essential minerals and phytonutrients needed proper nutrition and wellness thereby diminishing the nutritional value of the flour and the products derived from it, also nutrients and phytonutrients are not evenly distributed throughout the grain; most of nutrient's concentration is higher in outer part of the grain, so differential milling or refining results in reduced nutrient content except starch Slavin et al. (1999). This work focused on evaluating the nutritional quality of these tuwo samples from the target population households in Matsango-Azare Katagum Local Government area of Bauchi State.

Cereals are carbohydrate rich foods limiting in some essential amino acids. Owing to its lower cost and easy processing technologies, it's becoming a staple diet for many populations. Refining cereal grains simultaneously leads to loss of essential nutrients in the process of de-hulling, milling and sieving and in the process essential macro and micro nutrients needed for nutrition and wellness are lost. Resources of poor communities in the northeastern Nigeria are unable to afford costly foods of animal origin but depend on starchy cereal based foods such as tuwo for sustenance. The use of single cereal grain in communities of low nutrient supply may lead to deficiency diseases. It is therefore imperative to undertake a survey which will identify the state of malnourishment in a community with adverse consumption of tuwo made from single cereal grain flour of millet, rice, maize, corn. The study developed lasting solutions to malnourished communities recommending value addition techniques to tuwo made from these cereal grains as sensitized.

The aim of this study was to investigate the nutritional composition of various tuwo produced in Matsango area of Azare town in Katagum Local Government. Organize a survey to obtain data on tuwo types, determine nutrient and anti-nutrient profiles of tuwo commonly consumed in the locality and to embark on a sensitization campaign on the basis of research outcome for improved community nutritional status.

MATERIALS AND METHODS

Method of Data Collection

Data was randomly obtained from different households in Matsango Azare, Katagum Local Government area of Bauchi State. Appropriate procedures of following through the district head were given proper consideration before obtaining access to the community members. Two Samples of tuwo for each grain flour-type were collected from the households and taken to the laboratory for analysis.

Proximate Composition Analysis

For the determination of proximate composition (Moisture, Ash, Lipids, Protein, Carbohydrate and Crude fiber) of the samples, AOAC (1990) Method, as described by the Official Methods of Analysis was employed.

Quantitative Determination of Phytochemical by Spectroscopy

Phyto-nutrients as total alkaloids, flavonoids, steroids, terpenoids, tannins, and saponins were determined using standard procedures of AACC (2010)

Statistical Analysis

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Determinations were done in duplicates and the data generated were subjected to one-way analysis of variance (ANOVA) at 5% ($p<0.05$) and the means separated using the Least Significance Difference (LSD) method Gomez and Gomez (1984). The statistical analysis was carried out using MINI TAB version 17.

RESULTS AND DISCUSSON

Presented in Table 1 below is the proximate composition (wet basis) of different porridges collected from households in Matsango-Azare metropolis, Katagum Local Government of Bauchi State. The porridges collected were processed from the grains of Maize, Millet, Rice and Guinea corn.

The moisture content ranged from 58.3940-68.3760%. T_{G1} had the highest moisture content with 68.3760% and the moisture content is least in T_{R1} containing 58.3940%. The high moisture content might be attributed to the nature of processing/preparation, and vice-versa in the case of low content.

Table 1: Proximate Composition (Wet Basis) of Different Porridges (tuwo) Made From Maize, Millet, Rice and Guinea Corn

S/N	Sample	% Moisture	% Ash	% Fat	% Protein	% Carbohydrate	% C/Fiber
1	T_{M1}	65.2550±0.0410^{c}	0.6520±0.0396^{b}	2.0600±0.0735^{bc}	7.6560±0.0000^{cde}	24.3770±0.0750^{b}	0.7130±0.0014^{cd}
2	T_{M2}	66.0885±0.0148^{c}	0.5970±0.0071^{b}	2.2690±0.2080^{b}	8.2030±0.7740^{bcd}	22.8430±0.5440^{bc}	0.8075±0.0078^{bc}
3	T_{Mi1}	63.8240±0.1386^{d}	0.8320±0.0141^{a}	3.1100±0.1329^{a}	10.0000±0.0000^{ab}	22.2340±0.0198^{bcd}	1.0695±0.0898^{a}
4	T_{Mi2}	62.8580±0.150^{e}	0.7990±0.0014^{a}	2.9365±0.0672^{a}	10.9400±0.0000^{a}	22.4690±0.0905^{bcd}	0.9390±0.0467^{ab}
5	T_{R1}	58.3940±0.3820^{g}	0.3620±0.0198^{de}	1.7950±0.0240^{c}	6.0170±0.7750^{e}	33.4320±1.1610^{a}	0.6010±0.0297^{de}
6	T_{R2}	59.6770±0.4370^{f}	0.3000±0.0028^{e}	1.9090±0.0042^{bc}	6.5650±0.0000^{de}	31.5490±0.4300^{a}	0.4960±0.0057^{e}
7	T_{G1}	68.3760±0.0453^{a}	0.4300±0.0170^{cd}	2.0840±0.1075^{bc}	8.7500±0.0000^{bc}	20.3600±0.0453^{d}	0.8670±0.0042^{bc}
8	T_{G2}	67.0115±0.0134^{b}	0.4865±0.0021^{c}	2.2760±0.0509^{b}	8.2030±0.7740^{bcd}	22.0230±0.8400^{cd}	0.9490±0.0580^{ab}

Keys; T_{M1} AND T_{M2}= Maize Porridge first and second households, T_{Mi1} AND T_{Mi2}= Millet Porridge first and second households, T_{R1} AND T_{R2}= Rice Porridge first and second households,T_{G1} AND T_{G2}= Guinea corn Porridge first and second households,

Values on the Same Column, with different Superscript are Significantly Different ($P \leq 0.05$).of moisture. The moisture content found in these samples is comparable to the result of Salihu et al. (2021) on Fura Production from pearl millet commonly consumed in north east Nigeria. The moisture content levels in both studies indicated high moisture content levels, this implies lower storage stability, and low moisture stability indicates better storage stability Ayo et al. (2012). There is significant difference between all the samples except for T_{M1} and T_{M2}. The variation might be due to differences in processing. Akoja and Coker (2018) also quoted that Food and Agricultural Organization (FAO) recommended 12 to 14% for moisture content of flour-based products, hence the tuwo samples collected under thus study have increased possibility of microbial attack thus reducing its shelf stability.

The crude protein content ranged from 6.0170-10.9400%. T_{Mi2} had the highest crude protein level of 10.9400% whereas T_{R1} had the least content of crude protein of 6.0170%. The high content of protein in millet might be attributed to its high protein content. Many studies revealed higher percentage of protein in foods of millet grain over these cereals Gupta et al. (2009), FAO (1995). Crude protein levels were found to be significantly different ($P<0.05$) in households where tuwo from the same grain were collected. The protein of tuwo made from wheat-okro flour ranged from 10.56-21.93% as reported by Akoja and Coker, (2018), indicating disagreement with the results obtained in this current study. High protein content quoted by Akoja and Coker

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(2018) might be attributed to substitution of Okra which justifies an increase in proteins.

The ash content ranged from 0.3000-0.8320% in the samples collected and analyzed. T_{Mi1} had the highest ash content (0.8320%) while T_{R2} had the least amount of ash content (0.3000%). The result in this study indicated no significant differences between Tuwo collected from different household of the same grain. The amount of ash content in this study is comparable to the results of Agbara et al. 2018 on Yartsala production and the results of Salih et al. (2021) on the evaluation of Fura from pearl millet. The result is also low compared to the report of Basirat et al. (2021), who reported ash content of Maize tuwo as 1.52-1.71%in the studies concerning assessment of tuwo made from maize flour modified with maize and cassava starch. The low content in this study might be attributed to nature of different processing treatments by the households.

The fat content ranged from 1.7950-3.1100% in the samples of tuwo collected for the grains of maize, millet, rice and guinea corn. Tm1 had the highest fat content (3.1100%) and T_{R1} had the least fat content of 1.7950%. There is no significant difference ($P<0.05$) between values obtained for same grains of tuwo at different households but significant difference ($P<0.05$) but significant difference ($P<0.05$) exist between the values of tuwo obtained for different grain type. The crude fat in this study was low when compared to the results of Basirat et al. (2021) on Malted Maize tuwo and the results of Salihu et al. (2021) in pearl millet-based Fura respectively. The low fat content might likely be attributed to lack of substitution of the tuwo samples with another legume by the households. Fat contributes greatly to the energy value of foods, slow down the rate of utilization of carbohydrate Ilelabuye (2018).

Fiber contents of tuwo varied from 0.4960-1.0695%. The percent fiber content was highest in T_{Mi1} with 1.0950 and least in T_{R2} with 0.4960%. There is no significant difference ($P<0.05$) between samples collected for Maize and Guinea corn, significant difference exist between the fiber content level of tuwo from millet and rice. The high fiber content might be attributed to the grain millet, being a fiber rich grain. The result is comparable to the finding of Agbara et al. (2024) on quality characteristics of pearl millet-based Kunu which ranged between 0.70-0.78%.

The carbohydrate content ranged from 20.3600-33.4320%. Tuwo from T_{R1} had the highest carbohydrate content where is T_{G1} had the least amount of Carbohydrate (20.3600%). The high amount of Carbohydrate in T_{R1} might be attributed to difference pattern of processing by the households. De-hulling and other processing conditions that might draw a lot of nutrients could be the cause of low amounts of carbohydrate. There was no significant difference between ($P<0.05$) different tuwo producing households of same grain type. The study of tuwo production from Maize by Basirat et al. (2021) varied significantly. The low carbohydrate level in this study might be linked to poor processing practices by the residents of Matsango area in Katagum Local Government, Bauchi State.

Table 2: featured results of phytochemical profiles of different porridges made from Maize, millet, guinea corn and rice as samples from Matsango area in Katagum Local Government, Bauchi State.

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Table 2: Some Phytochemicals of Different Porridges (tuwo) Made From Maize, Millet, Rice and Guinea Corn.

S/N	Sample	Alkaloids (mg/100g)	Flavonoids (mg/100g)	Terpenoids (mg/100g)	Glycosides (mg/100g)	Steroids (mg/100g)	Tannins (mg/100g)	Saponins (mg/100g)
1	T_{M1}	1.0590±0.0750^{c}	2.1175±0.0064^{b}	0.6945±0.0247^{c}	0.6110±0.0078^{fg}	0.9040±0.0240^{c}	2.7685±0.0912^{f}	4.0915±0.0742^{b}
2	T_{M2}	1.0115±0.0163^{c}	1.9650±0.0297^{b}	0.594±0.0085^{cd}	0.7970±0.0325^{de}	0.9990±0.0042^{c}	3.2385±0.0559^{d}	3.8225±0.0629^{c}
3	T_{Mi1}	2.7270±0.0707^{a}	3.0620±0.0849^{a}	1.117±0.0127^{a}	1.0015±0.0007^{c}	1.5895±0.1025^{b}	5.2545±0.0686^{a}	4.7950±0.0297^{a}
4	T_{Mi2}	2.6050±0.0792^{a}	2.9570±0.0693^{a}	1.0540±0.0764^{ab}	0.8620±0.0792^{d}	1.3750±0.0509^{b}	4.4735±0.0799^{b}	5.0320±0.0424^{a}
5	T_{R1}	0.6950±0.1174^{d}	0.8650±0.0665^{e}	0.4005±0.0021^{e}	0.5160±.0028^{g}	1.3720±0.0396^{b}	2.8940±0.0085^{ef}	1.6915±0.0431^{e}
6	T_{R2}	0.6830±0.0014^{d}	1.0565±0.0771^{de}	0.5200±0.0028^{de}	0.7045±0.0233^{ef}	1.3875±0.0163^{b}	2.2000±0.0113^{g}	1.1575±0.0658^{f}
7	T_{G1}	1.8180±0.0622^{b}	1.4120±0.0424^{c}	1.1130±0.0028^{a}	1.5025±0.0191^{a}	2.0670±0.0919^{a}	3.7070±0.0919^{c}	2.9200±0.1075^{d}
8	T_{G2}	1.6950±0.0099^{b}	1.2700±0.0594^{cd}	0.9475±0.0714^{b}	1.3375±0.0064^{b}	1.9510±0.0693^{a}	3.0595±0.0714^{de}	3.1640±0.0679^{c}

Keys; T_{M1} AND T_{M2}= Maize Porridge first and second households, T_{Mi1} AND T_{Mi2}= Millet Porridge first and second households, T_{R1} AND T_{R2}= Rice Porridge first and second households,T_{G1} AND T_{G2}= Guinea corn Porridge first and second households,
Values on the Same Column, with different Superscript are Significantly Different ($P \leq 0.05$).

The phytochemical concentration (mg/100g) ranged as follows, alkaloid 0.6830-2.7270 mg/100g, flavonoid 0.8650-3.0620 mg/100g, terpenoids 0.4005-1.1170 mg/100g, glycosides 0.5160-1.5025 mg/100g, steroids 0.9040-2.0670 mg/100g, tannins 2.2000-5.2545 mg/100g, saponins 1.1575-5.0320 mg/100g. Total alkaloids, flavonoids, tannins, saponins and terpenoids were highest in samples of tuwo collected from pearl millet.

The highest content of these anti-nutrients might be attributed to the difference in processing operations compared to the tuwo processed using rice, sorghum, maize. It might also be that most tuwo processed using millet grains are found to be un-dehulled. Soaking and de-hulling in addition germination removes most anti-nutrients and when not dne, makes flours retain many of these phytonutrients. Despite high content of these in samples containing tuwo from households which processed millet grain flour to produce tuwo, the results revealed lower counts compared to the results of Salihu et al. (2021) on fura produced from pearl millet and the report of Owheruo et al. (2018) regarding physicochemical characteristics of malted finger millet. There is no much data regarding the content of terpenoids, glycosides, and steroids in grain flours of cereals of maize, millet, rice and sorghum, however studies by Perveen (2018) reported terpenoids to play key roles in human health.

CONCLUSION

The research aimed at identifying nutritional composition of tuwo from different households in the study area. Proximate composition and anti-nutritional status of these samples revealed moderate results. Nutrients were different due to different handling and processing differences by the households. The use of legume as supplement, protein-rich grain was emphasized to the residents during our sensitization exercise. Its use can improve the proximate composition of the tuwo produced from single cereal-based flour as are most used by residents of Matsango area Azare Katagum Local Government Bauchi State.

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