Health Values of Cassava Compared To Wheat and Yam: A Critical Review of Carbohydrate/Fibre and Fat/Fibre Ratios

Bonaventure C. Onodu[1], Richard J. Culas[1] and Ezekiel. U. Nwose[2*]

***Abstract* —** Beyond nutritional values are the pharmacological potentials of cassava comparative with other staple carbohydrate plant-based foods such as wheat. The knowledge of applicability to diabetes and its cardiovascular complications management seems not just limited, but unacknowledged. As a preliminary study, carbohydrate/fibre and fat/fibre ratios of cassava is investigated in view of diabetes and dyslipidaemia concerns. Critical reanalysis of a report data was performed, especially comparing carbohydrate/fibre and fat/fibre ratios of cassava with wheat yam and in view of dyslipidaemia. Fat/fibre ratios are negligible in unprocessed products (<2), but x55 higher in processed (flours) wheat and x5 in yam than cassava. Carbohydrate/fibre ratios are also negligible in unprocessed products (<10), but significantly x14 higher in processed (flours) wheat and x4 yam than cassava. There is evidence that relative to wheat meal, for instance, cassava contributes less fat and much more fibres. Since fat is pro-obesity, which in turn is pro-diabetic/metabolic syndrome, and fibre is anti-dyslipidaemic; cassava has pharmacological values to be appreciated over some carbohydrate plant-based foods.

Index Terms — cassava, diabetes, dyslipidaemia, medical nutrition therapy, value chain.

I. Introduction

It is important to expatiate the furor that diabetic patients are being advised to abandon cassava [1], which has been speculated to either cause or exacerbate diabetes [2-4], despite opinions that cassava is highly unlikely to cause diabetes [3-5]. There is plausible report on flour-based meals in Nigeria that presents comparative carbohydrate, fat, and fibre values of cassava relative to wheat and yam [6], and corroborating international databases contain foods' components for comparison [7]. However, a critical discussion of how the different foods may contribute to management of diabetes and dyslipidaemia is lacking.

Mechanisms of anti-lipidaemic effect of fibre have been identified to include inhibition of bile reabsorption from the stomach by soluble fibres, which in a positive feedback response format enhances the hepatic uptake of cholesterols for more bile productions [8]. Cassava contains phytochemicals comparable to other plant-based carbohydrate food sources such as wheat [9]. With the ongoing prediabetes and cardiovascular complications study (PACCS) programme; and given the lack of pharmacological data vis-à-vis medical nutritional therapy (MNT) value of cassava in diabetes and dyslipidaemia, this project intends to critically review a report that compares fat and fibre content.

Manuscript received August 9, 2014. (Write the date on which you submitted your paper for review.) This work was supported in part by the U.S. Department of Commerce under Grant BS123456 (sponsor and financial support acknowledgment goes here).

[1]School of Agriculture and Wine Sciences, Charles Sturt University

[2]School of Community Health, Charles Sturt University. 346 Leeds Pde Orange NSW 2800, Australia.

II. Method – *Critical Review Of A Published Literature*

Data on components of edible (processed flour) portions of cassava, wheat and yam presented in the report of Fasanmade and Anyakudo were reanalysed [6]. As per the title of report, it was focused on glycaemic index and not dyslipidaemia. However, values indicating comparative fat and fibre contents were contained. In this critical review, data as presented in result were re-analysed with a focus on dyslipidaemia. Discretionally, it was first premised on 'assuming equal weights of cassava, wheat and yam flour were mixed and eaten'. The compositions of each food item in 100g edible portions were viewed in a ratio to each other.

Another data on nutrition components of unprocessed food were obtain from *AUSNUT 2011-13* AHS food nutrient database [7]. Considering commonly consumed average portion size of each flour being 378g [10]; and based on data regarding the macronutrient components in processed and unprocessed food items, the comparative ratios of carbohydrate/fibre and fat/fibre were worked out using Excel analysis tool PAK

III. Results

Result show that assuming equal amounts of the three products were mixed and eaten together, cassava give least fat and most fibre while wheat is the opposite (Fig 1).

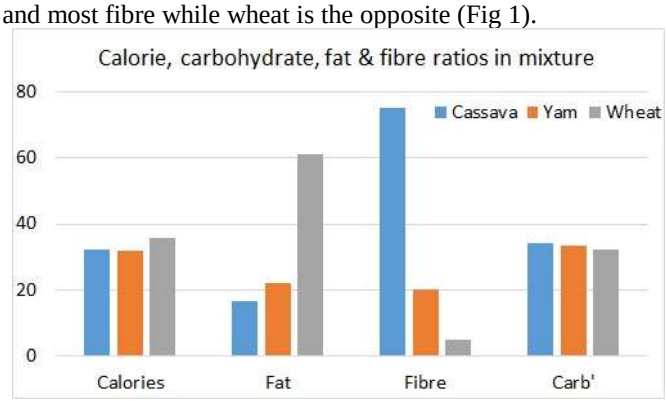

Fig 1: Comparative fat and fibre contents of cassava wheat and yam [6]

Fat/fibre ratios are negligible in unprocessed products, but x55 higher in processed (flours) wheat and x5 in yam than cassava (Fig 2; assuming reference <2) [11].

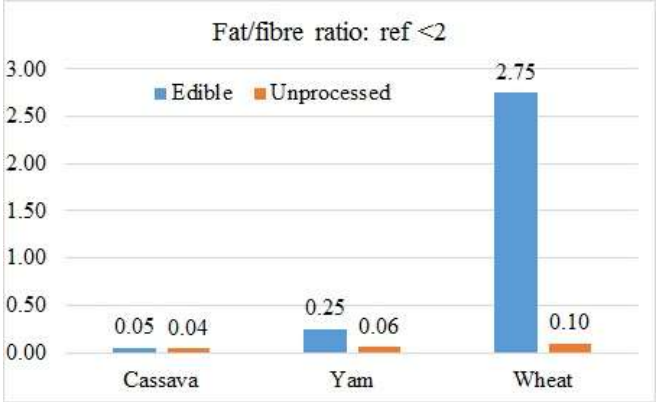

Fig 2: Comparative fat/fibre ratios of cassava wheat and yam

Carbohydrate/fibre ratios are also negligible in unprocessed products (<10), but significantly x14 higher in processed wheat and x4 yam than cassava (Fig 3; assumed reference ≤10) [12]

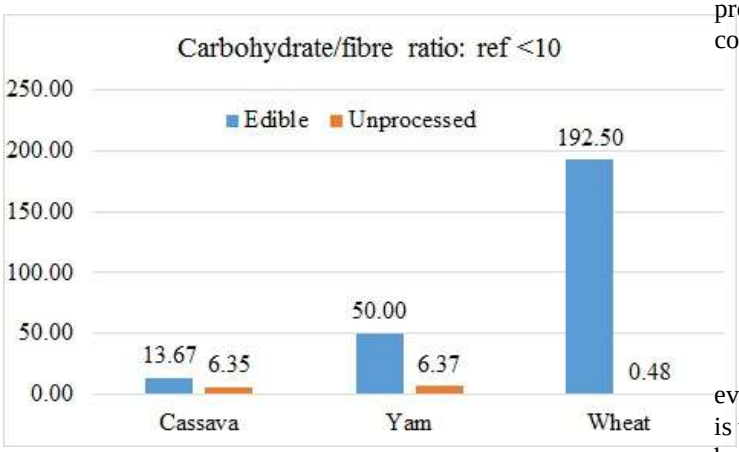

Fig 3: Comparative carbohydrate/fibre ratios of cassava wheat and yam

IV. DISCUSSIONS

The critical review of comparative fat and fibre contents of cassava relative to wheat and yam flour shows that

- Assuming equal amounts were mixed and eaten together, wheat will contribute most of the absorbable fat and much less anti-dyslipidaemic fibre while cassava is at the opposite side of the spectrum (Fig. 1).
- Fat/fibre ratio of the alternatives may be inconsequential in their unprocessed form, but value is considerably less in cassava by x55 in processed wheat and x5 in yam (Fig 2).
- Carbohydrate/fibre ratios are also seemingly negligible in unprocessed products, but value in cassava is less by x14 in processed wheat and x4 in yam (Fig 3).

It is known that dietary fibre is capable of reducing the risk of metabolic syndrome including diabetes and dyslipidaemia [13-15]. It is also known that differences in level of fibre nutrients constitute a factor in dietary management of cardiovascular disease [16]. In particular, fat/fibre and/or carbohydrate/fibre ratios are inferable, or recommended, respectively [11, 12]. The gap in knowledge is the therapeutic value of cassava for diabetes and dyslipidaemia management relative to other flour meals such as wheat. Indeed, studies on nutritive and phytochemical composition of cassava have reported different medicinal values, but made no mention on use of cassava for diabetes and dyslipidaemia management [17]; just as hypolipidaemic Nigerian flora were listed without mentioning cassava [18]. It has been said that in diabetes, "cassava could be a healthier choice than wheat and white potatoes" [6], but there is no scientific evidence in the literature on the use of cassava for diabetes and dyslipidaemia management. The lack of evidence is a justification for this study vis-à-vis preliminary survey, which is only a step in a long term research program.

There is no arguing the fact that a high-fiber diet is therapeutic [19]. What this paper is articulating and bringing to the fore is that processed cassava has a medical nutrition therapeutic value for diabetes and dyslipidaemia based on its healthier carbohydrate/fibre and fat/fibre ratios compared to processed wheat and yam (Fig 3), which will be appreciated by considering the following recommendations of adequate intake:

- Carbohydrate and fat are approximately 55% and 27.5% of calories, respectively [20]. This implies a carbohydrate/fat ratio of 2/1 or ≥2 for dyslipidaemia management. That is, for every 10g of carbohydrate consumed, at most 5g of fat may be the optimum.
- Carbohydrate/fibre ratio is ≤10, which means for every 10g of carbohydrate food consumed, at least 1g of fibre may be the healthy dietary requirement [12].

Given the recommendations or references, it may be that for every 10g of carbohydrates edible meal, 5g of fat and 1g of fibre is the required adequate intake. Hence the fat/fibre ratio need to be 5/1 or ≤5. However, recommended adequate intake of fibre is 14g per 1000 kcal [20], which translates to being 0.0014% of calories. This is inconsistent with 1g fibre per 5g fats or 10g carbohydrate inferred from the recommendation of Atkins et al [11]. Therefore, a pertinent consensus or elucidation is reference values for healthy carbohydrate/fibre and fat/fibre ratios.

With increasing knowledge and processing advancement, the nutritive benefit of cassava is inexhaustible. One will expect that with the high content of starch in cassava root and the many consumable end products, as well as the very fact that these products have been and remains the main staple intercultural food all around the world, there are several chemical agents in cassava that will protect against diabetes and dyslipidaemia/obesity. Without these occult agents, there would have been higher incidences of these conditions in our communities. Further studies will be encouraged in other to provide biochemical data to support these lines of thought. Also, the proposal following this hypothesis is to perform a community needs assessment and behavioural change wheel in terms of producers, processors, marketers, and consumers of

health (or MNT) economic value chain of cassava. This recent paper provides a start point in this directionThe word “data” is plural, not singular.

V. Conclusion

This study affirms that beside the dietary benefits of cassava as a staple food, it has therapeutic values that are being adopted in intercultural ethno-medicine. However, the hypolipidaemic potential is yet unknown and the relatively higher fibre content is still to be put into perspective. Evidence of the knowledge of possible use to lower hyperlipidaemia and regulate diabetes complications need to be investigated and translated into value chain potentials to maximize its health and overall economic benefits.

Acknowledgment

This is part of a PhD research work. The research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

References

[1] Eyambem E. Wheat flour, meal/ fufu from scratch Wives Connection 2014 [cited 14th Feb 2017]; Available from: http://www.wivestownhallconnection.com/2014/10/wheat-flour-meal-fufu-from-scratch.html

[2] Akanji AO. Cassava intake and risk of diabetes in humans. Acta Hortic 1994; 375: 349-60. https://doi.org/10.17660/ActaHortic.1994.375.35

[3] Beidler J. Is cassava a diet alternative for diabetics? Livestrongcom 2015 [cited 14th Feb, 2017]; Available from: http://www.livestrong.com/article/314844-cassava-as-diet-alternative-for-diabetics/

[4] Yessoufou A, Ategbo JM, Girard A et al. Cassava-enriched diet is not diabetogenic rather it aggravates diabetes in rats. Fundamental & clinical pharmacology 2006; 20: 579-86. https://doi.org/10.1111/j.1472-8206.2006.00443.x

[5] Swai AB, McLarty DG, Mtinangi BL et al. Diabetes is not caused by cassava toxicity. A study in a Tanzanian community. Diabetes Care 1992; 15: 1378-85. https://doi.org/10.2337/diacare.15.10.1378

[6] Fasanmade AA, Anyakudo M, M. C. Glycemic indices of selected Nigerian flour meal products in male type 2 diabetes subjects. Diabetologia Croatica 2007; 36: 33-8.

[7] Food Standards Australia New Zealand. Food nutrient database. AUSNUT 2011–13 2016 [cited 27th Feb 2017]; Available from: http://www.foodstandards.gov.au/science/monitoringnutrients/ausnut/pages/default.aspx

[8] Forman A. Foods that lower cholesterol. HowStuffWorks 2007 [cited 14th Feb, 2017]; Available from: http://health.howstuffworks.com/diseases-conditions/cardiovascular/cholesterol/foods-that-lower-cholesterol2.htm

[9] Eleazu OC, Eleazu KC, Kolawole S. Use of indigenous technology for the production of high quality cassava flour with similar food qualities as wheat flour. Acta scientiarum polonorum Technologia alimentaria 2014; 13: 249-56. https://doi.org/10.17306/J.AFS.2014.3.3

[10] Sanusi RA, Olurin A. Portion and serving sizes of commonly consumed foods in Ibadan Southern Nigeria. Afr J Biomed Res 2012; 15: 149-58.

[11] Atkins JL, Whincup PH, Morris RW et al. Dietary patterns and the risk of CVD and all-cause mortality in older British men. The British journal of nutrition 2016; 116: 1246-55. https://doi.org/10.1017/S0007114516003147

[12] Mozaffarian RS, Lee RM, Kennedy MA et al. Identifying whole grain foods: a comparison of different approaches for selecting more healthful whole grain products. Public Health Nutrition 2013; 16: 2255-64. https://doi.org/10.1017/S1368980012005447

[13] Zhou Q, Wu J, Tang J et al. Beneficial effect of higher dietary fiber intake on plasma HDL-C and TC/HDL-C ratio among Chinese rural-to-urban migrant workers. International journal of environmental research and public health 2015; 12: 4726-38. https://doi.org/10.3390/ijerph120504726

[14] Papathanasopoulos A, Camilleri M. Dietary fiber supplements: effects in obesity and metabolic syndrome and relationship to gastrointestinal functions. Gastroenterology 2010; 138: 65-72.e1-2.

[15] Chen C, Zeng Y, Xu J et al. Therapeutic effects of soluble dietary fiber consumption on type 2 diabetes mellitus. Experimental and therapeutic medicine 2016; 12: 1232-42. https://doi.org/10.3892/etm.2016.3377

[16] Hollænder PL, Ross AB, Kristensen M. Whole-grain and blood lipid changes in apparently healthy adults: a systematic review and meta-analysis of randomized controlled studies. Am J Clin Nutr 2015; 102: 556-72. https://doi.org/10.3945/ajcn.115.109165

[17] Ebuehi OAT, Babalola O, Ahmed Z. Phytochemical, nutritive and anti-nutritive composition of cassava (Manihot esculenta L) tubers and leaves. Nigerian Food Journal 2005; 23: 40-6.

[18] Nwodo NJ, Nnadi CO, Ibezim A, Mbah CJ. Plants with hypolipidaemic effect from Nigerian flora. Antioxidant-Antidiabetic Agents and Human Health: InTech 2014:242-55.

[19] Ahmed SM, Clasen ME, Donnelly JE. Management of dyslipidemia in adults. Am Fam Physician 1998; 57: 2192-204, 207-8.

[20] The National Academy of Sciences. Summary. Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids: The National Academies Press 2002:1 - 20.