Vol. 19(1), pp. 1-7, January, 2023
DOI: 10.5897/AJAR2022.16138
Article Number: 4F2316E70156
ISSN: 1991-637X

http://www.academicjournals.org/AJAR

ACADEMIC JOURNALS
expand your knowledge

African Journal of Agricultural Research

Full Length Research Paper

Pasting properties of high-quality cassava flour of some selected improved cassava varieties in Tanzania for baking

Mikidadi Abubakar[1]*, Peter Wasswa[1], Esther Masumba[2], Heneriko Kulembeka[2], Geoffrey Mkamilo[2], Edward Kanju[3], Emanuel Mrema[2], Wilfred Abincha[4] Richard Edema[1], Phinehas Tulkamuhabwa[1], Siraj Kayondo[3] and Patrick Ongom[3]

[1]Department of Agricultural Production, Makerere University, Kampala, Uganda.
[2]Tanzania Agricultural Research Institute (TARI), Tanzania.
[3]International Institute of Tropical Agriculture (IITA), Kano, Nigeria.
[4]Kenya Agricultural and Livestock Research Institute (KALRO), Kakamega, Kenya.

Received 7 July, 2022; Accepted 16 September, 2022

Partial substituting wheat with high-quality cassava flour (HQCF) in bread making would be economically beneficial in Tanzania. However, cassava varieties with the best pasting quality for this use are unknown. In addition, the appropriate time of harvesting the varieties to attain the best pasting quality is also unknown. This study, therefore, aimed at identifying the most appropriate cassava varieties and their appropriate harvesting time that could be used for production of HQCF for baking bread. Nine improved cassava varieties namely Kiroba, Mkuranga1, Pwani, Chereko, Mkumba, Hombolo, Orela, Kizimbani and Kipusa and two local varieties, Albert and Kibandameno were planted in 2020/2021 and 2021/2022 seasons at TARI-Ukiriguru using a split plot design. Harvesting was done at 10 and 12 months after planting (MAP). Pasting characteristics of the HQCF samples were determined at the International Centre of Tropical Agriculture, Dar es salaam, Tanzania using Perten Rapid Visco Analyzer (RVA) Tecmaster equipment, Model: N103802. The results indicated that KIPUSA had the lowest significant setback, while Hombolo had the highest significant setback both at 10 and 12 MAP suggesting that HQCF produced from KIPUSA should be considered for partial substitution of wheat in baking bread that is attractive to consumers.

Key words: Pasting temperature, setback, cassava application, wheat substitution, bread.

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is a perennial woody shrub with edible roots. Cassava roots are highly

*Corresponding author. E-mail: mikisb2340@yahoo.com.

perishable and can hardly be stored in the fresh state. The roots are therefore processed into more stable forms such as high-quality cassava flour (HQCF). HQCF is simply unfermented cassava flour, usually whitish or creamy in colour, odourless, bland or sweet in taste and free from adulterants, insect infestation, sand, peel fragments, dust, and any other impurities (Nanam TayDziedzoave et al., 2017). The HQCF can be used in baking to make products such as bread.

Majority of registered bakeries in Tanzania produce bread as their main product (Bennett et al., 2012). In bread making, the bakery factories use wheat flour as raw material. However, most of the wheat is imported because of low wheat production in the country. Wheat constituted Tanzania's highest expenditure on food in 2008. For example wheat imports in 2007/2008 were estimated to be 494,000 t, with an indicative import price of US$410 t^{-1} (Abass et al., 2013). This means that the country loses a lot of foreign exchange due to wheat importation.

Experience from other countries shows that the use of HQCF in bakery industries reduces importation of wheat and make cassava a potential commercial crop (IITA, 2010). According to FAO (2019), cassava is the most produced crop in Tanzania and is considered as a famine reserve when cereals fail due to its drought tolerance. In addition, cassava is cultivated and produced in all regions of Tanzania due to its adaptability to various soils and agro-ecological conditions and has a wider harvest window. Cassava can be harvested from six months to forty eight months after planting (Nweke et al., 2002). This wide harvest window implies that there is an assurance of supply of cassava as raw material for the production of HQCF throughout the year.

It should be noted that the use of different varieties as raw materials in HQCF production is undesirable (Apea-Bah et al., 2011; Iwe et al., 2017). This is because the pasting properties (behavior of a starch paste during and after cooking) of HQCF are variety specific. Therefore, baked food such as bread made from HQCF processed from fresh roots of a mixture of varieties will vary in volume, texture and appearance (Rojas et al., 1999; Shittu et al., 2007). Consequently, production of baked food with inconsistent quality could jeopardize the reputation of the baking factories to their customers.

Pasting property of HQCF is determined by peak viscosity, trough, breakdown, final viscosity, setback, peak time and pasting temperature which can be read from the pasting profile using a Rapid Visco Analyzer (RVA). Pasting temperature and setback are the most important pasting characteristics both for the industry and consumers, respectively. Pasting temperature is a measure of the minimum temperature required to cook a given food sample. Pasting temperature has an implication in the energy costs, thus it is an important pasting characteristics for the food industry in terms of costs of production. Varieties that have low pasting temperature are desirable for processing because low energy will be used during processing. Setback is related to starch retro gradation and higher setback is undesirable in many food products including bakery products. It can be concluded that pasting temperature and setback plays a big role in bread making. Determination of pasting temperature and setback of each variety should be considered before the variety is selected for production of HQCF for baking. Furthermore, the quality of cassava flour has been reported to be affected by harvesting time (Adeola et al., 2020; Iwe and Agiriga, 2015). Thus, there is a need to use same source of materials (that is, same variety) at an appropriate harvesting time in the production of HQCF on an industrial scale for baking.

In Tanzania, currently, there are no recommendations on cassava varieties that should be planted for production of HQCF for baking bread and their appropriate harvesting time. This study therefore was conducted to identify the most appropriate varieties and their appropriate harvest time for production of HQCF for baking bread.

METHODOLOGY

Study site

The study was conducted at Tanzania Agricultural Research Institute (TARI)-Ukiriguru in 2020/2021 and 2021/2022 seasons. TARI-Ukiriguru is located in Misungwi district (2° 43.1′ S, 33° 1.0′ E) at an altitude of 1198 m above sea level (Saidia and Mrema, 2016). TARI-Ukiriguru receives annual rain fall of about 930 mm (Johnson, 2013). This study area receives bimodal rainfall pattern, short rains falling from October to December, and long rains from March to May. The two seasons are separated by dry spell from June to September. TARI-Ukiriguru is located in the Lake Zone which is one of the largest producers of cassava in Tanzania. This is a strategic place for HQCF production for the Lake Zone.

Materials

Nine improved most farmer-preferred cassava varieties namely KIROBA, MKURANGA1, PWANI, CHEREKO, MKUMBA, HOMBOLO, ORELA, KIZIMBANI, KIPUSA were used. Two local farmer-preferred varieties, ALBERT and KIBANDAMENO were also included. These varieties were selected based on their merits (Table 1).

Experimental design

Planting was done following a split plot design with three replications with harvesting time as main plot and genotype as sub plot. Planting was done using a spacing of 1 m × 1 m and each subplot contained five rows of seven plants each. Harvesting was done from the net plots at 10 and 12 months after planting (MAP).

Preparation of HQCF samples

HQCF was prepared using a standard protocol (IITA, 2010).

Table 1. Characteristics of the materials planted.

Variety name	Release year	Characteristics
ORELA	2019	Tolerant to CBSD and CMD, high dry matter content
KIROBA	2019	Tolerant to CBSD and CMD, high dry matter content
KIZIMBANI	2019	Tolerant to CBSD and CMD, high dry matter content
MKUMBA	2019	Tolerant to CBSD and CMD, high dry matter content
MKURANGA1	2019	Tolerant to CBSD and CMD, high dry matter content
PWANI	2012	Tolerant to CBSD and CMD
CHEROKO	2014	Tolerant to CBSD and CMD
HOMBOLO	2014	Tolerant to CBSD and CMD
KIPUSA	2014	Tolerant to CBSD and CMD
KIBANDAMENO and ALBERT	NA	Local landraces famer preferred

Source: Authors

Healthy, firm, non-fibrous fresh cassava roots were harvested at 10 and 12 MAP. The cassava roots were peeled washed with clean tap water to remove dirt including sand, soil or other impurities. The washed cassava roots were grated into fine mash using a mechanical grater. The grated cassava mash was placed into a clean sack and pressed until it was crumbly and then it was dried in an oven at 60°C for 24 h. The dried cassava mashes were stored in cold conditions at 4°C until the time of determination of pasting properties. Dried mash was then milled to obtain HQCF at the time of analysis for pasting properties.

Determination of pasting properties of HCQF

Pasting characteristics of the HQCF samples were determined at the International Institute of Tropical Agriculture (IITA), Dar es salaam, Tanzania using a Perten Rapid Visco Analyzer (RVA) Tecmaster equipment, Model: N103802. First, 3.0 g of HQCF sample was weighed into a dry empty canister and 25 ml of distilled water was dispensed into the canister. The solution was thoroughly mixed and the canister was fitted into the RVA as recommended. The slurry was heated from 50 to 95°C with a holding time of about 4 s followed by cooling to 50°C with same holding time. Time between readings was 4 s. Setback and pasting temperature were read from the pasting profile with the aid of thermocline for windows software connected to a computer.

Data analysis

Analysis of variance (ANOVA) was carried out in R statistical software to assess variability among genotypes and across harvest time. The analysis was based on the general linear model specified:

$$y = MP + Season + Season/Rep + MP * Season + SP + SP * Season + MP * SP + MP * SP * Season$$

where MP = main plot (Harvest time), $Season/Rep$ = replication nested within season, SP = sub-plot (variety), $MP * Season$= interaction between main plot and season, $SP * Season$= interaction between sub-plot and season, and $MP * SP$= interaction between main plot and subplot.

Following ANOVA, Fisher's Least Significant Difference (LSD) was computed. Summary statistics and broad-sense heritability (H^2) and BLUPS of the two traits were also computed in R statistical software based on the full model.

RESULTS AND DISCUSSION

Pasting temperature

Pasting temperature is the minimum time required to cook a given starch sample. Results showed a significant effect (P<0.001) of variety and harvesting time on pasting temperature (Table 2). However, the interaction effect of variety and harvest time was not significant (Table 2). Significant effect observed here shows the prospects of selecting cassava varieties with desired pasting temperature for industrial application in baking bread. These results agree with other researchers that pasting temperature of starch or HQCF depends on both cassava variety (Shittu et al., 2007; Adeniji et al., 2010; Iwe et al., 2017), and harvest time (Adeola et al., 2020). Differences in pasting temperature could be due to differences in amylose content and starch granular size of the cassava varieties (Mtunguja et al., 2016). Pasting temperature at 10 MAP ranged from 71.12°C (KIZIMBANI) to 73.90°C (PWANI) with a mean of 72.51°C (Table 4), whereas pasting temperature at 12 MAP ranged from 72.43°C (HOMBOLO) to 74.51°C (PWANI) with a mean of 73.63°C (Table 5). Comparison of varieties across the two harvest times showed that pasting temperature ranged from 72.06°C (KIZIMBANI) to 74.23°C (PWANI) with a mean of 72.96°C (Table 7). The range of pasting temperature reported in the present study is within the range reported by earlier studies, 63.82 to 75.47°C (Santos et al., 2022), and 67.9 to 74.4°C (Aldana et al., 2013). The results from the present study indicated that pasting temperature increased from 10 to 12 MAP (Table 6). Harvesting before 12 MAP seems to be more profitable in energy saving due to lower pasting temperature. Besides, the results showed that all the varieties at all the harvesting times have a pasting temperature lower than 74°C which is the minimum

Table 2. Analysis of variance on the effect of variety, harvesting time and their interaction on pasting temperature for the two seasons 2020/2021 and 2021/2022.

Source of variation	Df	Mean square
Season	1	402.22***
season/Rep	4	2.67
harvest_time	1	32.00**
harvest_time: season	1	0.07
Pooled error 1	4	0.31
Variety	10	4.02***
season:variety	10	1.05
harvest_time:variety	10	0.77^{ns}
harvest_time:season:variety	10	0.49
Pooled error 2	66	1.06

Df=Degrees of freedom, ns=non-significant, **, *** =significant at 0.001 and 0.01, respectively.
Source: Authors

Table 3. Analysis of variance on the effect of variety, harvesting time and their interaction on setback for the two seasons 2020/2021 and 2021/2022.

Source of variation	Df	Mean square
Season	1	106406.00^{ns}
season/Rep	4	85884.00
harvest_time	1	47078.00^{ns}
harvest_time:season	1	212537.00
Pooled error 1	4	32885.00
Variety	10	562728.00***
season:variety	10	77650.00
harvest_time:variety	10	99685.00**
harvest_time:season:variety	10	156523.00
Pooled error 2	67	35994.00

Df=degrees of freedom, ns=non-significant, **, *** =significant at 0.001 and 0.01, respectively.
Source: Authors

pasting temperature for baking according to standards (Tables 4 and 8). Furthermore, KIZIMBANI had the lowest pasting temperature whereas PWANI had the highest implying that the best variety for food industries in terms of energy saving was KIZIMBANI while PWANI was the least. The broad sense heritability value of pasting temperature was 0.73 (Table 7), suggesting that the pasting temperature trait in cassava can be easily improved genetically.

Setback

The viscosity after cooling to 50°C represents setback or viscosity of the cooked paste. Results showed that setback viscosity varied (p<0.001) among varieties (Table 3). Harvest time had no significant effect on setback whereas the interaction between variety and harvest time was significant (P<0.01). These results agree with earlier findings which reported that setback varied among cassava varieties (Chisenga et al., 2019). Furthermore, results showed that KIPUSA had the lowest setback viscosity at 10 MAP (Table 3) and 12 MAP (Table 5) and across the entire time factor (Tables 7 and 8). Results also showed that HOMBOLO had the highest setback viscosity at 10 MAP (Table 4), 12 MAP (Table 5) and across seasons (Tablws 7 and 8). Differences in setback viscosity could be due to differences in starch granular size and amylose content (Mtunguja et al., 2016). The heritability of this trait was 0.80 which is high. The high heritability value indicates the relative ease of improving varieties for this trait using recurrent selection.

Table 4. Comparison of varieties for setback and pasting temperature at 10 months after planting at Ukiriguru, Tanzania.

Variety	Setback (Cp)	Group	Variety	Pasting_Temp (°C)	Group
HOMBOLO	1160.67	a	PWANI	73.90	A
KIROBA	1047.80	ab	MKURANGA1	73.62	Ab
KIBANDAMENO	1027.00	ab	KIROBA	73.16	Abc
ALBERT	983.83	ab	KIBANDAMENO	72.89	Abc
MKURANGA1	974.33	ab	ALBERT	72.88	Abc
MKUMBA	961.00	ab	MKUMBA	72.22	Bcd
ORELA	922.67	bc	HOMBOLO	72.21	Bcd
KIZIMBANI	846.17	bcd	CHEREKO	71.94	Cd
PWANI	720.80	cd	ORELA	71.83	Cd
CHEREKO	671.17	d	KIPUSA	71.82	Cd
KIPUSA	650.67	d	KIZIMBANI	71.12	D
Mean	906.01			72.51	
Min	650.67			71.12	
Max	1160.67			73.90	
CV%	19.91			1.65	
EMS	32577.26			1.42	
SEM	180.49			1.19	

Values followed by different letters are significantly different from each other, otherwise they are non-significant.
Source: Authors

Table 5. Comparison of varieties for setback and pasting temperature at 12 months after planting at Ukiriguru, Tanzania.

Variety	Setback (Cp)	Group	Variety	Pasting_Temp (°C)	Group
HOMBOLO	1312.60	A	PWANI	74.51	A
KIBANDAMENO	1300.83	A	ALBERT	74.45	Ab
KIROBA	1239.00	A	ORELA	74.24	Ab
MKURANGA1	1190.00	A	MKUMBA	73.81	Abc
ORELA	1077.25	Ab	MKURANGA1	73.78	Abc
KIZIMBANI	1039.50	Abc	KIZIMBANI	73.46	Bcd
ALBERT	905.25	Bcd	KIROBA	73.44	Bcd
MKUMBA	779.00	Cd	KIPUSA	73.16	Cd
CHEREKO	713.50	D	KIBANDAMENO	72.93	Cd
PWANI	698.50	D	CHEREKO	72.66	D
KIPUSA	310.80	E	HOMBOLO	72.43	D
Mean	960.57			73.53	
Min	310.80			72.43	
Max	1312.60			74.51	
CV%	21.25			1.04	
EMS	40470.56			0.59	
SEM	201.17			0.77	

Values followed by different letters are significantly different from each other, otherwise they are non-significant.
Source: Authors

The setback viscosity indicates the tendency of the dough to undergo retrogradation. Starch retrogradation causes bread stalling (the change in texture and flavor of bread during storage). Bread stalling indicates low consumer acceptance of bakery products. Lower setback values indicate that the flour can be used for products where longer fresh storage of bread is required (Wani et al., 2016; Zhang et al., 2020). Since KIPUSA had significant the lowest setback values then, the results suggest that this is the best variety for production of

Table 6. Comparison of varieties for setback and pasting temperature between the two harvest times at Ukiriguru, Tanzania.

Harvest_time	Pasting_Temp (°C)	Group	Setback	Group
12	73.50	A	946.58	A
10	72.46	B	906.69	A
Mean	72.98		926.63	
Min	72.46		906.69	
Max	73.50		946.58	
CV%	1.41		20.51	
EMS	1.06		35993.76	
SEM	1.03		189.72	

Values followed by the same letter are non-significant different from each other.
Source: Authors

Table 7. Comparison of varieties for setback and pasting temperature across both harvest times and 2020/2021 and 2021/2022 seasons at Ukiriguru, Tanzania

Variety	Setback (cP)	Groups	Variety	Pasting_Temp (°C)	Groups
HOMBOLO	1229.73	A	PWANI	74.23	A
KIBANDAMENO	1163.92	A	MKURANGA1	73.70	Ab
KIROBA	1132.78	Ab	ALBERT	73.51	Ab
MKURANGA1	1072.36	Abc	KIROBA	73.28	Bc
ORELA	984.50	Bcd	MKUMBA	73.01	Bcd
ALBERT	952.40	Cd	KIBANDAMENO	72.91	Bcde
KIZIMBANI	923.50	Cd	ORELA	72.80	Bcde
MKUMBA	870.00	D	KIPUSA	72.43	Cde
PWANI	708.64	E	HOMBOLO	72.31	De
CHEREKO	692.33	E	CHEREKO	72.30	De
KIPUSA	496.18	F	KIZIMBANI	72.06	E
Mean	929.67			72.96	
Min	496.18			72.06	
Max	1229.73			74.23	
CV%	20.51			1.41	
EMS	35993.76			1.06	
SEM	189.72			1.03	
h^2	0.80			0.73	

h^2=Broad sense heritability.
Source: Authors

HQCF for partial substituting wheat in baking bread, while HOMBOLO is the worst.

Conclusion

All the varieties had pasting temperature less than 74°C which is the minimum pasting temperature for baking at all the harvesting times. On the other hand, KIPUSA had the lowest setback viscosity which is the desirable characteristics for baking bread that is attractive to consumers. Thus, KIPUSA is the best cassava variety and HQCF from KIPUSA can be recommended as an alternative for partial substituting wheat in baking bread to be stored fresh for a long time whereas HOMBOLO is the worst variety. To the best of our knowledge this is the first report to recommend the best cassava variety in Tanzania to be used for production of HQCF for partial substituting wheat in baking bread that can be stored fresh for a long time.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

Table 8. BLUPs on pasting temperature and setback among varieties across seasons and harvesting times at Ukiriguru, Tanzania.

Variety	Pasting temperature (°C)	Setback (cP)
ALBERT	71.69	976.37
CHEREKO	71.08	766.97
HOMBOLO	71.21	1201.58
KIBANDAMENO	71.52	1146.10
KIPUSA	71.05	598.08
KIROBA	71.28	1108.57
KIZIMBANI	70.62	950.61
MKUMBA	71.60	909.80
MKURANGA1	71.84	1084.14
ORELA	71.19	997.96
PWANI	72.33	783.98

Source: Authors

ACKNOWLEDGEMENTS

The authors thank Cornell University through NEXGEN CASSAVA PROJECT for the financial support, TARI for facilitating the experimental fields for the growing of the cassava roots, IITA for providing conducive environment during the laboratory work at their laboratory in Dar es Salaam, Tanzania and Makerere University through Makerere Regional Centre of Crop Improvement for Technical support.

REFERENCES

Abass AB, Mlingi N, Ranaivoson R, Zulu M, Mukuka I, Abele S, Bachwenkizi B, Cromme N (2013). Potential for commercial production and marketing of cassava: Experiences from the small-scale cassava processing project in East and Southern Africa. Ibadan, Nigeria: IITA

Adeniji TA, Hart AD, Tenkouano A, Barimalaa IS, Sanni LO (2010). Comparative study of pasting properties of improved plantain, banana and cassava varieties with emphasis on industrial application. African Journal of Food, Agriculture, Nutrition and Development 10(5):2601-2614.

Adeola AA, Idowu MA, Oyatogun RM, Adebowale AR, Afolabi WA, Adigbo SO (2020). Quality of cassava flour as affected by age at harvest, cropping system and variety. Agricultura Tropica et Subtropica 53(4):187-198.

Apea-Bah F, Oduro I, Ellis W. O, Safo-Kantanka O (2011). Factor Analysis and Age at Harvest Effect on the Quality of Flour from Four Cassava Varieties. World Journal of Dairy and Food Sciences 6(1):43-54.

Bennett B, Naziri D, Mahende G, Towo E (2012). Driving demand for cassava in Tanzania : the next steps Draft report (Issue May).

Chisenga SM, Workneh TS, Bultosa G, Laing M (2019). Characterization of physicochemical properties of starches from improved cassava varieties grown in Zambia. AIMS Agriculture and Food 4(4):939–966. https://doi.org/10.3934/agrfood.2019.4.939

IITA (2010). Cassava in the tropical Africa. A reference manual. International Institute of Tropical Agriculture. Wisbech, Baldings and Mansell International.

Iwe MO, Agiriga A N (2015). Effect of Different Harvesting Regimes on the Pasting Properties of Selected Varieties of Banana – A Response Surface Study Agrotechnology 4(1):1-10. https://doi.org/10.4172/2168-9881.1000132

Iwe MO, Michael N, Madu NE, Obasi NE, Onwuka GI, Nwabueze TU, Onuh JO (2017). Physicochemical and Pasting Properties High Quality Cassava Flour (HQCF) and Wheat Flour Blends. Agrotechnology 6:167. doi: 10.4172/2168-9881.1000167

Johnson L (2013). Assessing the Relationship Between Weather Parameters on Cotton (Issue July). http://dspace.cbe.ac.tz:8080/xmlui/handle/123456789/769

Mtunguja MK, Laswai HS, Kanju E, Ndunguru J, Muzanila YC (2016). Effect of genotype and genotype by environment interaction on total cyanide content, fresh root, and starch yield in farmer-preferred cassava landraces in Tanzania. Food Science and Nutrition 4(6):791-801. https://doi.org/10.1002/fsn3.345

Nanam TayDziedzoave AB, Abass A, Amoa-Awua WKA, Sablah M (2017). Production of high quality cassava flour. BMC Public Health *5*(1):1-8.

Nweke F, Spencer D, Lynam J (2002). The Cassava Transformation. Michigan State University Press.

Rojas JA, Rosell CM, De Barber CB (1999). Pasting properties of different wheat flour-hydrocolloid systems. Food Hydrocolloids 13:27-33.

Saidia PS, Mrema JP (2016). Effects of farmyard manure and activated effective microorganisms on rain-fed upland rice in Mwanza, Tanzania. Organic Agriculture 7(2):83-93. https://doi.org/10.1007/s13165-016-0154-6

Santos CS, Sousa MB, Brito AC, de Oliveira LA, Carvalho CW, de Oliveira EJ (2022). Genome-wide association study of cassava starch paste properties. Plos One 17(1):e0262888.

Shittu TA, Sanni LO, Awonorin SO, Maziya-Dixon B, Dixon A (2007). Use of multivariate techniques in studying the flour making properties of some CMD resistant cassava clones. Food Chemistry 101(4):1606-1615.. https://doi.org/10.1016/j.foodchem.2006.04.017

Wani IA, Sogi DS, Sharma P, Gill BS (2016). Physicochemical and pasting properties of unleavened wheat flat bread (Chapatti) as affected by addition of pulse flour. Cogent Food and Agriculture 2(1):1124486. https://doi.org/10.1080/23311932.2015.1124486

Zhang Y, Nie L, Sun J, Hong Y, Yan H, Li M, You X, Zhu L, Fang F (2020). Impacts of Environmental Factors on Pasting Properties of Cassava Flour Mediated by Its Macronutrients. Frontiers in Nutrition *7*:1-9.