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EFFECT OF STEAM BLANCHING ON TRIFOLIATE YAM (*D. dumetorum*) FLOUR CHEMICAL COMPOSITION AND ACCEPTABILITY OF ITS MIXTURE WITH WHITE YAM FLOUR THICK PASTE ('AMALA')

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ABSTRACT

Trifoliate yam (*D. dumetorum*), one of the *Dioscorea spps* cultivated in West Africa that is almost going into extinction despite it reported higher nutritional value and present of some valuable phytochemical. Traditionally, trifoliate yam is consumed as a cooked snack by blanching/cooking in hot water, depletion of its nutrients and its physicochemical have been reported. Blanching in a steam under a varied time (15, 25, 35 and 45minutes) was studied to determine its effect on sensory, chemical composition, and phyto-chemical properties of trifoliate yam. Trifoliate yam flour of a relatively low nutrient loss was used to substitute white yam (D. rotundata) flour for thick paste (Amala) production at varied ratio (100: 0; 30: 70; 20: 60 and 50:50). The "Amala" produced were subjected to sensory evaluation in terms of taste, texture, appearance and overall acceptability by 20 panelists who are familiar with "Amala" using 9 point Hedonic scale. The result shows a realative percentage loss 1% protein while there was a negligible increment in fat, ash, and fiber at 15 minutes of blanching. There was a progressive nutrients and mineral loss as blanching time increased to 35 and 45 minutes. Phytochemicals in sample blanched for 15 minutes was higher compared with those blanched for 35 and 45 minutes and it showed a significant loss as the blanching time increased. Blanching in steam for 15 minutes produced flour of average nutrients retention. Substitution of white yam flour with trifoliate yam flour at 60:40 ratios is more acceptable to the consumers.

Keywords: Trifoliate yam, Steam blanching, chemical composition, white yam flour, "Amala", Acceptability.

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INTRODUCTION

Yams of *Dioscorea species* are major food crops grown in West Africa, Southeast Asia and the Caribbean. These yams provide up to half the total caloric intake in the diet of the West African population (Martins et al., 1983; Egbe et al., 1984). Among yam species, Cultivation of Dioscorea dumnetorum (trifoliate yam) is widespread in Western Cameroon with a yield three to seven times higher than those of other species being cultivated (Egbe et al., 1984) and the shape of the tuber makes it conducive to harvesting by mechanical means (Agbor Egbe and Treche, 1995; Afoakwa and Sefa-Dedeh, 2001).

The nutritive value of Dioscorea dumetorum yams is well documented (Agbor Egbe & Treche, 1995) and a relatively high crude protein content of 9-10.2% and a favorable nitrogen/energy balance with calcium content in raw and boiled yam was 42.9 mg/100 g and 41.1 mg/100 g respectively Studies also show that of all the yams of the *Dioscorea* species, *D. dumetorum* has the highest yield of starch (88.03% on a dry basis), smallest starch size and a high gelatinization temperature and a poor binding characteristics (Afoakwa and Sefa-Dedeh, 2002). Trifoliate yam varieties have Tannin, Saponin, Alkaloids (*Dioscorine*) and other phenolic substances that have been exploited by traditional medicine in treating cancer and treatments of some stomach diseases. (corley et al., 1985; Fenwick et al., 1990; Okezie & Onuma , 1995). The toxicity of its alkaloid with mice revealed the LD50 value for intra-peritoneal administration to be approximately 65 mg/kg (Bevan et al., 1956). However, traditional processing methods have been used to reduce these alkaloid by baking, boiling (water), or leaching of sliced tubers in running water overnight to give a mild taste (Corley et al., 1985; Okezie and Onuma, 1995). The bitter substances of Tannin, Phenol, Saponin, Oxalate, Alkaloids) lend characteristic flavors that are rarely appreciated and more often avoided, and, therefore, limit the acceptance and consumption of products made from *D. dumetorum* yam (Abiodun and Oladapo, 2010).

However, traditional form of processing yam especially *D. rotundata* into flour (Elubo) and instant flour (Iyan) is by blanching /cooking in hot water and soaking in nthe blanching water for 12hrs and then dried in open sun before milling to flour. The flour is often reconstituted in hot water to make a thick paste “Amala” meal commonly eaten in the Yoruba areas of Nigeria and its sensory properties is well accepted (Jimoh and Olatidoye, 2009; Babajide eta al., 2007). Blanching in water has been shown to have more negative effects on nutritional composition of yam tubers and Ezeocha, 2014 showed that cooking trifoliate yam in hot water gave a high loss of about 28% in nutrients compared to freshly harvested yam. While blanching *D. rotundata* in hot water has been shown to have significant effect on the pasting characteristics of the constituted flour (Amala) (Jimoh and Olatidoye, 2009). Also, hot air oven drying has been shown to have little effect on pasting characteristics but sun drying produce a more elastic and a

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higher brown –index (Abulude and Ojediran, 2006; Adebowale et al., 2014; Catherine and Elizabeth, 2011). However, effect of steam blanching condition (temperature and time) on trifoliate yam flour chemical composition (nutritional and phyto-chemicals) and its eventual effect of mixture with D.rotundata flour (Elubo) to make Amala remain scanty. Therefore, this study was conducted to verify the effects of steam blanching temperature and time on the chemical composition of the flour and its applicability of substitution potential in traditional yam flour thick paste (Amala).

MATERIALS AND METHODS

Sample and sources: Trifoliate yam was obtained from farmers at Saki (Oyo North of Oyo state Nigeria) and was transported to Food Science and Technology Laboratory (The Oke- Ogun Polytechnic Saki) for processing and analysis. The tubers were washed, allowed to drain and kept under ambient condition for 6hrs before further processing was done. While white yam (*D. rotundata*) chips were obtained from Sango market at Saki and was milled into flour (Elubo) using local Tosso mill at Saki market.

Sample preparation: Tubers were peeled and sliced to about 3 mm thick and then divided into two portions.

Traditional method sample: Method described by Jimoh and Olatidoye, (2009) was used to blanch in boiling hot water (100^{O}C) in an aluminum pot fired by gas cooker the yam chips and was left in soaking water for 12hrs. After blanching, the chips was drained and dried in an open sunlight using the laboratory glass cover solar dyer and then milled into flour using a Torso Disc mill. The milled flour was then packaged in an HDPE bag and was stored at 4^{O}C to served as control samples.

Steam Blanched sample: The second portions were then subjected to steam blanching by using a water bath blancher with steam produced at 105^{O}C. Trifoliate yam chips was put in a stainless sieve and was placed on top of a stand inside the steam blancher and sample were withdrawn at different time of (15, 25, 35 and 45mins.). it was drained and then dried in an air dried oven set at 55^{O}C until a constant weight was obtained. This was then milled into flour, packaged in HDPE bag and kept at 4^{O}C until further uses.

Thick paste "Amala" Preparation: The applicability of the trifoliate yam was done by making a composite flour mixture of D. rotundata (white yam) flour (Elubo) with trifoliate yam flour at the following ratio (0: 100; 80:20; 70: 30: 60: 40 and 50:50). The mixture was reconstituted by cooking in a hot water to form thick paste (Amala) with a continuous stirring with wooden spoons to prevent lumpiness. After the thick paste was formed, the meal was latter wrapped in polyethylene nylon and was put inside a cooler for sensory analysis.

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Proximate analysis: Moisture, ash, crude fat, and protein were determined by AOAC (2000) method. Dietary fiber was determined by the method described by Asp et al., 1983 and carbohydrate was calculated by difference (%CHO = 100- (sum of Moisture, fat, protein, fiber and crude ash). The bitterness principles of Saponins were determined by methods described by Harbone (1973), the Alkaloids by Okezie (1995), total phenol by Pearson (1999) and Tannin by Okwu and Ndu (2006). Mineral of Na, K, Fe and Mg was determined by AOAC(2000) method and Phosphorus was determined by method described by Smith and Caruso, (1964).

Sensory Evaluation: 20 consumer panelists selected among the students and staff of The Oke-Ogun Polytechnic, Saki who are familiar with eaten white yam "Amala" were presented the paste samples using complete randomization method. They were asked to score for sensory attributes of colour, taste, texture, and overall acceptability using 9 point hedonic scale ranking method where 9= like extremely; 8 = like very much; 7 = like moderately; 6= like slightly' 5= neither like nor dislike; 4 = dislike slightly; 3 – dislike moderately; 2 = dislike very much; 1 = dislike extremely.

Statistical Analysis: Data were conducted in triplicate and the result was expressed as mean ± standard error. The statistical operation was performed using SPSS statistical software version10.0 and mean were compared by using Duncan multiple range test and P(0.05) was applied to establish significant difference.

RESULTS AND DISCUSSION

Table 1 shows extent of depletion in the nutritional values of hot water blanched and the steam blanched trifoliate yam over a varied time. In terms of moisture content, steam blanched samples have varied moisture uptake between 8.13 - 8.53 % in which at 15 minutes it had (8.43%), 25 mins (8.300), 35 minutes (8.13) and 45 minutes (8.53) Compared to the hot water blanching soaking overnight, steam blanched samples has higher moisture content. The protein retained was higher in steamed blanched sample at 15 minutes (3.20) than the hot water blanched sample (3.17) but, depletion became higher as the time of steam blanching increases as shown in 25 minutes (2.97%); 35 minutes (2.80%) and 45 minutes (2.97%). Crude Fat content at 15 minutes remains higher (0.40%) compared to hot water blanched sample (0.37%) but depletion of steam blanched sample were higher as the time of steaming increases as shown in 25 minutes (0.30%), 35 minutes (0.23%) and 45 minutes (0.23%). Also, ash content has highest value in he steam blanched samples at 15 minutes (2.27%) compared to hot water blanching (2.13%) but depletion becomes higher as time of blanching increases as shown in 25 minutes (2.07), 35 minutes (1.93%), and 45 minutes (1.83%). In terms of crude fiber steam blanched sample at 15minutes had higher value (0.87%) compared to hot water blanched sample (0.73) while progressive decrease in content was noticed as the time of steam blanchi8ng increases as shown

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at 25 minutes (0.77%), 35 minutes (0.67%) and 45 minutes (0.60). However, carbohydrates content in the steam blanched sample increases as the time of blanching increases as shown in the sample at 15 minutes (84.83%), 25 minutes (85.60%), 35 minutes (86.23%) and 45 minutes (85.83%) which is not significantly difference (P<0.05) from the hot water blanched sample (85.77%). These results agreed with Ezeocha and Oti (2014) that blanching or cooking or soaking in water of trifoliate yam will gives a higher depletion of nutrients while blanching in steam will retains nutrients as discussed by Catherine et al., 2011; Chen et al., 1971; Corcuera et al., 2004. However, this result has shown that nutrients retentions will depends on ytime of steam blanching for trifoliate yam as shown that at 15 and 25 minutes of steam blanching, nutrient retention was relatively high compared to 35 and 45 minutes of blanching most especially protein, fat, ash and fiber. This implies that short time high temperature will favour nutrients retention than longer period of blanching.

Table 1: Proximate Composition of steam blanching at varied Time and Hot water blanching (12 hour overnight soaked) of Trifoliate yam flour.

Blanching Process	**Time (Mins)**	**Moisture %**	**Protein %**	**Fat %**	**Ash %**	**Fiber %**	**CHO %**
Steam	15	8.43±.153	3.20±.100	0.40±.000	2.27±.058	0.87±.058	84.83±.058
Steam	25	8.30±.100	2.97±.115	0.300±.100	2.07±.115	0.77±.057	85.60±.300
Steam	35	8.13 ±.153	2.80±.361	0.23±.058	1.93±.058	0.67±.058	86.23±.251
Steam	45	8.53±.153	2.97±.058	0.23±.058	1.83±.058	0.60±.000	85.83±.058
Hot water (soaking overnight)	12hr	7.70 ±.088	3.17±.053	0.37±.058	2.13±.153	0.73±.056	85.77±.153

Table 2 indicates the result of the mineral composition of the steam and hot water blanching and soaking in blanched water overnight (12hrs). In terms of sodium content value steam blanched samples at 15 minutes (268.33) shows a higher value significantly higher (P>0.05) compared to the hot water blanching value (246.67). While the steam blanched samples shows a lower value at 25 minutes (240.00mg/100g), 35 minutes (221.67mg/100g) and 45 minutes (211.67mg/100g). Also, in term of Potassium (K) a higher value was noticed at 15 minutes (15.67mg/100g) compared to hot water blanched sample (14.67mg/100g), while in steam blanching it decreased significantly (P<0.05) as shown in 25 minutes (12.67mg/100g), 35 minutes (11.67mg/100g) and 45 minutes (10.33mg/100g). The result also shows that Iron (Fe) content varies with a higher value shown in 15 minutes sample (2.00mg/100g) compared to hot water blanching (1.53mg/100g) but a progressive decrease was noticed as the time of steam blanching increases as shown in 25 minutes (1.53mg/100g), 25 minutes (1.23mg/100g) and 45 minutes (0.57mg/100g). Also, in magnesium (Mg) content the steam blanched sample at 15 minutes of blanching retain the highest value (13.67mg/100g) compared to hot water blanching (11.33mg/100g). The steam blanched samples shows a significant decrease as shown in 25 minutes (10.00mg/100g), 35 minutes (8.67 mg/100g) and 45 mi8nutes (7.67mg/100g). Phosphorus contents also varies in value with steam blanching at 15 minutes having higher value (125mg/100g) compared to the hot water blanching (113.33mg/100g). While phosphorus depletion was progressively lowered as time of blanching increases as shown in 25 minutes (105mg/100g), 25 minutes (98.33mg/100g) and 45 minutes (88.33mg/100g). This shows that mineral content could be retained at short time high temperature of team blanching than hot water blanching which Catherine et al 20011 shows that steaming of food will retain high nutrients while blanching in water was shown by Ezeocha et al 2011 in a related experiment comparing the freshly harvested trifoliate yam and water cooked trifoliate yam having higher depletion of about 28% loss.

Table 2: Mineral content of steam blanching at varied Time and Hot water blanching (12hour overnight soaking) of Trifoliate yam flour.

Blanching Process	Time (Mins)	Na (mg/100g)	K (mg/100g)	Fe (mg/100g)	Mg (mg/100g	PO_4 (mg/100g)
Steam	15	268.33±2.89	15.67±0.58	2.00±0.13	13.67±1.15	125.00±0.56
Steam	25	240.00±0.00	12.67±0.58	1.53±0.01	10.00±0.24	105.00±1.45
Steam	35	221.67±2.89	11.67±0.56	1.23±2.04	8.67±0.03	98.33±0.45
Steam	45	211.67±2.89	10.33±0.58	0.57±2.35	7.67±0.46	88.33±1.24
Hot water (soaking overnight)	12hr	246.67±2.89	14.67±0.58	1.53±2.46	11.33±0.43	113.33±1.48

Table 3 shows the result of the phyto-chemicals content of the blanched trifoliate yam. Alkaloid content decreased from 2.50 to 1.63, 1.50 and 1.17 mg/100g at 15, 25, 35 and 45 minutes of steam blanching respectively. Blanching in hot water had lower value (2.30) than steam blanching at 15 minutes. In terms of Tannin content of the samples, tannin value decreases as time of steam blanching decreases as shown in the values at 15 minutes (18.33mg/100g), 25 minutes (12.23mg/100g), 35 minutes (11.00mg/100g) and 45 minutes (10.33mg/100g) and hot water blanching had lower value (14.83mg/100g) compared to steam blanching at 15 minutes. The total Saponin also varies as time of steam blanching increases as shown in the values at 15

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minutes (10.67mg/100g), 25 minutes (4.17mg/100g), 35 minutes (1.50mg/100g) and 45 minutes (1.50mg/100g) with the hot water blanching value (7.83mg/100g) lower than the 15 minutes of steam blanching. While in terms of Phenol values the depletion was also significant with steam blanching value at 15 (21.17mg/100g) having higher values than the hot water blanching (18.68mg/100g) while a significant difference ($P<0.05$) in steam blanched samples is shown in 25 minutes sample value (16.33mg/100g), 35 minutes (14.50mg/100g) and 45 minutes (13.33). These values agrees with Egbuonu et al., (2014) ; Enwer and Menkiti, (2009) that soaking in water will decrease phyto-chemicals in trifoliate yam slices. The decrease in steam blanched and hot water blanching and soaking overnight shows a significant depletion as moisture uptake increases.

In all the blanched samples (steam and hot water) an average higher nutrients retention and minimal phyto-chemicals reduction was obtained at 15 minutes of steam blanching compared to the other steam blanched samples time of 25, 35 and 45 minutes, although the bitterness factors could be reduced at a longer period of steam blanching the time of 15 minutes could still give a mild taste that which does not reach the threshold of toxicity as reported by Egbuonu et al., 2014

Table 3: Anti-nutritional Factors of steam blanched at varied Time and Hot water blanched (12hour overnight soaking) of Trifoliate yam flour.

Blanching Process	Time (Mins)	Alkaloids (mg/100g)	Tannin (mg/100g)	Saponin (mg/100g)	Total Phenol (mg/100g
Steam	15	2.50±2.45	18.33±1.5	10.67±2.08	21.17±2.04
Steam	25	1.63±0.03	12.23±2.58	4.17±0.58	16.33±0.56
Steam	35	1.50±2.58	11.00±1.45	1.50±2.58	14.50±1.58
Steam	45	1.17±1.45	10.33±0.05	1.50±1.58	13.33±1.58
Hot water (soaking overnight)	24hr	2.30±0.25	14.83±0.56	7.83±0.45	18.68±2.58

Table 4 shows the application of trifoliate yam flour steam blanched at 25 minutes in composite with white yam flour thick paste "Amala" sensory properties. In tem of taste, sample 60 : 40 white yam flour : trifoliate yam flour sample scored the highest rank (5.33) and is significantly different from other samples. The least in rank in term of taste was the 100% trifoliate yam flour. The values closer to 60:40 ratio is sample 70:30 (3.89), 80:20 (3.44) and sample 50:50 (1.33). The implication is that white yam flour addition could mask the bitter taste and give an acceptable "Amala" paste. In terms of appearance consumers preferred sample 70:30 (6.22) and closer to it without significant difference is 50:50 (6.22) followed by 60:40 (6.00), 80:20 (4.33). the least in rank is 100 % trifoliate yam "Amala" (1.67) score. While in terms of texture,

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consumers highly preferred sample 50:50 (6.00) which is followed by samples 70:30 (5.00), sample 70:30 (4.11) and sample 80:20 (4.11) while the 100% trifoliate yam Amala was the least acceptable (1.00). The overall acceptability ranking shows that consumer still preferred sample 60:40 (4.44) moderately followed by 70:30 (4.11), 50:50 (3.56), 80:20 (3.22) while the least acceptable is the 100% trifoliate yam flour Amala having a score of (1.00). These results shows that white yam in composite with trifoliate yam flour at ratio of 60:40 will produce an acceptable Amala pate which consumers can like and this will increase the utilization of trifoliate yam as its poor properties of not having good binding as shown in the textural value scores by the panelist could be improve on as shown in Ezeocha et al. (2011) utilizing cocoyam as a composite to trifoliate yam that gives appreciable acceptability at varied levels.

Table 4: Sensory properties of Trifoliate Yam flour Blended with white yam flour at varied ratio compared to 100% traditionally processed trifoliate yam flour "Amala"

Sample	Taste	Appearance	texture	Overall Acceptability
A	1.11^{d}±0.11	1.67^{c} ±0.17	1.00^{d} ±0.00	1.00^{d} ±0.00
B	3.44^{b}±0.58	4.33^{b}±0.71	4.11^{bc} ±0.79	3.22^{a} ±0.72
C	3.89^{b} ±0.42	6.22^{a}±0.48	5.00 ^{ab} ±0.33	4.11^{a} ±0.35
D	5.33^{a} ±0.50	6.00^{a}±0.44	4.11^{bc} ±0.63	4.44^{a} ±0.65
E	1.33^{cd} ±0.24	6.22^{a} ±0.28	6.00^{a} ±0.17	3.56^{a} ±0.47

Note : A =100:0 (Trifoliate yam flour)

B = 80: 20 (White yam Flour : Trifoliate yam flour)

C = 70: 30 (White yam Flour : Trifoliate yam flour)

D = 60:40 (White yam Flour : Trifoliate yam flour:)

E = 50:50 (White yam Flour : Trifoliate yam flour:)

CONCLUSION

The result in terms of nutrient nutrients retention shows that steam blanching increases nutrient retention compared to hot water blanching but retention reduces as the time of blanching increases . however, an average higher nutrient retention and minimal phytochemical reduction was obtained at 15 minutes of steam blanching. A composite flour of 40% trifoliate yam flour and 60% with white yam flour (D.rotundata) mixed together in the production of "Amala" was found to be highly acceptable that other mixtures ratios and consumers did not notice any bitter taste as it was masked by the white yam. This composition is expected will be good to serve as

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functional food with the level of phyto-chemicals and high protein and fiber retained in the samples.

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