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The effect of steam and hot water blanching on some quality attributes of cocoyam leaf

Abstract

Cocoyam leaf, an African Indigenous vegetable locally referred to as kontomire among the Akans in Ghana is used in the preparation of sauces ('kontomire' stew) and soups ('ebunebunu'). The work aimed at determining the effect of steam and hot water blanching methods on colour, flow rate, total soluble solids, pH and sensory attributes of cocoyam leaf puree. Cocoyam leaf puree was produced using both steam and hot water blanching methods. Fifty (50) panellists evaluated the organoleptic properties of soups made from the produced purees using a 9-point hedonic scale. There was significant difference ($p<0.05$) between steam and hot water blanched purees in terms of colour, consistency and mouth feel. The hot water blanched puree sample was the most preferred in terms of all the attributes. There was a significant difference between steam blanched and hot water blanched puree samples in terms of their pH, flow rate and colour. The pH of steam and hot water blanched purees were 6.06±0.01 and 6.40±0.02 respectively. Hot water blanched samples recorded a lower flow rate while steam blanched samples recorded a higher a-value in terms of colour. There was no significant difference in the total soluble solids contents of steam blanched and hot water blanched puree samples. The sensory attributes, flow rate and total soluble solids content of hot water blanched puree makes it a better method for the processing of cocoyam leaf puree.

Keywords: bostwick constituency, kontomire, pheophytisation, ebunuebunu, homogenous texture, colour degradation

Volume 2 Issue 5 - 2016

Puree Collins Quarcoo, Faustina D Wireko-Manu

Department of Food Science and Technology, Kwame Nkrumah University of Science and Technology, West Africa

Correspondence: Puree Collins Quarcoo, Department of Food Science and Technology, KNUST, PMB Kumasi, Ashanti Region, Ghana, Tel +233548621166, Email cquarcoo28@gmail.com

Received: April 05, 2016 | **Published:** July 14, 2016

Introduction

Cocoyam leaves are obtained from cocoyam crop which belongs to the monocotyledonous family Araceae known as the aroids. According to Igbabul et al.[1] "Cocoyam (*Colocasiaesculenta*) is an edible, highly nutritious and an underutilized crop as compared with the other root and tuber crops". Cocoyam leaves are consumed in the tropics and subtropics as a leafy vegetable. In Ghana the leaves, locally referred to as kontomire among the Akan ethnic group is used in the preparation of sauces ('kontomire' stew) and soups ('ebunebunu'). The leaves are also used for wrapping foods for example, in Tonga the leaves of Taro are used to wrap corned beef to produce a product called 'lupulu.[2]' In spite of the vast usage of the leaves in areas of cocoyam cultivation, the consumption of the leaves has been limited to within a week of harvest because of its perishability. Studies on cocoyam leaves so far have focused on the effects of cooking conditions on the nutritional and anti-nutritional properties of the leaves, however very little work has been done to add value to the leaves. Value addition to crops in a bid to increase their utilization includes processing of these crops into forms such as purees.[3]

Purees are prepared by grinding, milling or sieving the edible part of cooked fruit or vegetable. The fruit or vegetable is subjected to cooking usually blanching for about five minutes before blending using a kitchen machine (blender).[4] Several fruits and vegetables have been processed into purees. Regardless of raw material or processing purees are desired when they have consistent qualities.[5] For instance Codex states that processed tomato puree shall have good flavor and odour, fairly good red colour, and shall possess a homogeneous (evenly divided) texture, characteristic of the product. The processing conditions in the manufacture of many products affect the final product qualities. Thermal processing and the addition of stabilizers have been shown to affect the final quality of purees. Hence the purpose of this study is to determine the effect of different processing conditions on some quality attributes of cocoyam leaf puree.

There is less diversification in the use of cocoyam leaves and no documentation is available on the quality of cocoyam leaf puree produced using steam and hot water blanching methods in Ghana. The processing of cocoyam leaves into puree would present the leaves in an alternative form for use and bring about ease of processing. The project would also add to literature on the best processing conditions for obtaining cocoyam leaf puree with high quality attributes.

Materials and methods

Sources of materials

Fresh cocoyam leaves were obtained from Dome market in Accra. Measurements of colour, pH and Total Soluble Solids were done at the processing lab of CSIR-FRI, Accra. Flow rate determination was done at the glass blowing section, Chemistry department, University of Ghana.

Sample preparation

Leaves obtained were washed under running water to get rid of dust and particles. The leaves were then washed in vinegar solution and then shredded to thin slices using knives. A total amount of (1.2kg) of leaves was used for the processing of the leaves. This is divided into three portions of 400g each. One portion served as the control sample and the rest as treated samples

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Treatments

Hot water blanching: A portion of 400g of shredded leaves was blanched using hot water for 3mins. The leaves were introduced into the sauce pan when the water reached a temperature of 100°C.

Steam blanching: Another portion of 400g of shredded leaves was steam blanched using an automated steam cooker for 5mins. After blanching Samples were weighed.

Puree making: Using a Panasonic mixer grinder, each of the samples was pureed for 2mins at power level 3. Prior to blending 200ml of water was added to each sample. The blended samples were stored in labeled 178ml glass jars.

Analysis on cocoyam leaf puree

Colour: A Minolta Hunter lab colour meter was used in the measurement of the colour of the processed samples. The a-value, b-value and L-value of cocoyam leaf purees produced were determined. The instrument was standardized with a white ceramic plate (L_o=96.55, a_o=-0.35, b_o=-0.16). The readings were taken in triplicates. The Hue (h), Chrome (C) and Total colour difference (E) of the cocoyam leaf puree was calculated using the formula below:

$$C = \left(a^2 + b^3\right)^{1/2}$$

$$h = tan^{-1}\left(b/a\right)$$

$$E = \left[\left(L - L_o\right)^2 + \left(a - a_o\right)^2 + \left(b - b_o\right)^2\right]^{1/2}$$

Total Soluble solids and pH: Portions of the samples were taken for pH and Total soluble solids determination. The pH of samples was determined in triplicates 30minutes after preparation and an hour after preparation using a HANNA H1 pH meter at (24°C).

The Total soluble solids contents for each sample were determined using the HANNA hand held refractometer. The blended samples were first squeezed through a cheese cloth to obtain a less cloudy extract. The determination was on the extract.

Flow: Flow rates of the purees produced using steam and hot water blanching methods were determined by using a modified Bostwick consistency method. About 50ml of each sample was filled into a cylindrical tube of 30mm external diameter, 27mm internal diameter and glass tube end of 10mm external diameter and 7mm internal diameter. The glass tube end was fitted with a stopper. The stopper was removed to allow the sample flow for 20seconds into a beaker. Amount of puree collected after 20seconds was calculated as the flow rate per second.

Sensory evaluation: The purees from each processing method were used in preparation of ebunuebunu soups for sensory evaluation. Some of the puree samples were stored for five days before use in soup making. Samples were coded with three-digit random numbers. A total number of fifty assessors were used to access the soups produced using the puree in the sensory lab at FORIG, KNUST. Aroma, colour, mouth feel, consistency, taste, thickness and overall acceptability of soups produced from the puree was assessed using a 9-point Hedonic scale for their degree of likeness, with 1 representing dislike extremely and 9 representing like extremely.

Statistical analysis

All analysis was done in triplicates. The effect of steam blanching and hot water blanching methods on the colour, pH, TSS, Flow and Sensory attributes of cocoyam leaf puree was determined by analysis of variance (ANOVA) and significant difference of means were compared using Fisher's LSD test.

Results and discussion

Total soluble solids content of steam and hot water blanched cocoyam leaf puree

The hot water blanched and the control [untreated] samples both had total soluble solids (TSS) contents of 1.00°Brix which was lower than 1.8°Brix total soluble solids content of the steam blanched sample. The higher value of the TSS in the steam blanched sample however was not significantly different from that of Hot water blanched sample and the control sample at $p<0.05$. The total soluble solids content of the steam blanched sample was in line with values obtained by Kaushal et al.[6] for the TSS content of fresh cocoyam leaves which ranged from 1.8-3.2°Brix. Total soluble solids are contributed to by sugars which are water soluble. One main disadvantage of Hot water blanching is the leaching of nutrients and other water soluble components into the water used for blanching.[7] The lower TSS value of the hot water blanched sample could be attributed to the sugars leaching into the water used for blanching. Hot water blanching therefore caused a decrease in the total soluble solid content of cocoyam leaf as compared with steam blanching method although not significantly different. Total soluble solids have an impact on the consistency of purees. The higher the total soluble solids content the higher the consistency of the puree.[8]

Influence of steam blanching and hot water blanching on flow rate of cocoyam leaf puree

Flow rate or consistency of modern day purees are factors in determining the quality of a puree because it determines the rheological properties of the puree.[9] The flow rate obtained for the hot water blanched, steam blanched and the control samples were 1.78ml/s, 2.08ml/s and 2.54ml/s respectively. Higher flow rate values indicate less consistent puree. More viscous fluids have lower flow rates.[10] The hot water blanched sample was more viscous than the other samples since values obtained for the flow rates of all the samples were significantly different at $p<0.05$, with hot water blanching method producing a puree of higher consistency as compared to steam blanching method. Different methods used [steam and hot water blanching methods] could explain the varying flow rates of the cocoyam leaf purees produced. The consistency of a puree is dependent on many variables among which are; variety of fruit or vegetable being used, the type of "break", particle size and method used in obtaining the puree.[11] These values were higher as compared with that of tomato puree of 0.79ml/s.[10]

Effect of Steam Blanching and Hot Water Blanching on pH of Cocoyam Leaf Puree

The pH of samples were (6.06, 6.40 and 5.76) for steam blanched, hot water blanched and control samples respectively. The heat treatments caused significant ($p<0.05$) increase in the pH values of

Citation: Quarcoo PC, Wireko-Manu FD. The effect of steam and hot water blanching on some quality attributes of cocoyam leaf. *MOJ Food Process Technol.* 2016;2(5):164–168. DOI: 10.15406/mojfpt.2016.02.00050

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cocoyam leaves with hot water blanching treatment causing a more significant increase in pH than the steam blanching treatment. Heat treatments generally affect heat labile components of foods such as ascorbic acid.[6] Soluble acids such as oxalic acids also leach into water during cooking.[12,13] These are some of the contributing factors in pH rise of the cocoyam leaves during blanching. Both blanching methods destroyed some heat labile acids leading to a decrease in acidity but hot water blanching method further dissolved the soluble acids in the cocoyam leaves thus leading to further decrease in acidity. Comparing pH results obtained (5.76-6.40) to those obtained by Kaushal et al.[6] (7.70-7.76), the cocoyam leaves used for processing of the puree is slightly more acidic. The difference in pH could be attributed to differences in variety, soil condition and the physiological stage of growth of the leaves. The pH of any food material gives an indication of microbial safety of the food Materials; lower pH values indicate higher microbial stability. Changes in pH can lead to chlorophyll degradation and thus affect the colour of fruits and vegetables.[6] There was however no observable colour difference (Table 1).

Effect of steam blanching and hot water blanching on color of cocoyam leaf puree

Colour of a food product can influence the choice of consumer in purchasing that food product. Hence the need to compare colour of same products to standards. Interpreting colour in numerical values allows for easy comparison. The L-values obtained for the purees were (41.90±1.35, 35.61±0.02 and 47.26±1.09) for steam blanched, hot water blanched and control puree samples respectively. From the results, the control sample had a significantly lighter colour. These values compare favorably with the L-values of green chili puree (47.24) obtained by Ahmed et al.[14] and that of green beans (38.00±080 by Martins et al.[15] From Table 2 there was a significant difference between the a-value of the non-treated (control) sample (-10.00±0.13) and the a-values of steam blanched puree sample (-1.51±0.11) and the hot water blanched puree sample (-6.03±0.16). This indicates a loss of colour in the treated samples which could be mainly attributed to pheophytisation.[15] Blanching can have both direct and indirect effects on colour. The former is exemplified by the destruction of pigments such as chlorophyll, by heat.[16] Steam blanching method gave a significantly lower a-value than hot water blanching method and this could be because the heat transfer coefficient of condensing steam is greater than that of hot water and as such higher chlorophyll loss in the steam blanched puree. The a-values for both the steam blanched and hot water blanched purees were lower than those obtained for other products were (-11.93) for green beans and (-10.42) for green chili puree.[14,15]

The hue of any product is simply how an object's colour is perceived [as red, green, orange, etc.]. The hue values obtained for green colour of the cocoyam leaf puree were (291.37o, 319.39o and 311.06o) for steam blanched; hot water blanched and control samples respectively. These values did not tally with hue values of green products which range from 180°-270°. This places the puree in a more blue range than green.

The Chromo of any product shows how vivid or dull the colour of a product is. Chromo is also known as saturation with a range from 0-60 and according to Konica 2007, values closer to 0 indicates a dull colour and those approaching 60 indicate more vivid colour. The purees produced from steam and hot water hot water blanching recorded Chromo values of 7.94 and 4.15 respectively, showing the puree from hot water blanching as more vivid than steam blanched puree sample. The purees however had a duller colour when compared with the Chromo values recorded for green chili puree and green beans which were 24.60 and (17.72) respectively.[14,15] The cocoyam leaf puree from the non-blanched sample recorded a Chromo value of 15.23 which was about twice that of the hot water blanched sample. The lower chromo values of the steam and hot water blanched methods could be attributed to the destruction of colour compounds by heat during blanching (Table 2).

Table 1 TSS, pH and Flow rate of cocoyam leaf puree

Sample	TSS (Brix)	pH	Flow rate(ml/s)
Steam Blanched	1.80±0.0^{a}	6.06±0.01^{a}	2.06±0.04^{a}
Hot Water Blanched	1.00±0.0^{a}	6.40±0.02^{b}	1.78±0.07^{b}
Control	1.00±0.0^{a}	5.76±0.01^{c}	2.54±0.06^{c}

Mean of triplicates of each sample±standard deviation (SD).

Different superscripts indicate significant difference amongst values within each column ($p \leq 0.05$).

Table 2 Color attributes of steam blanched, hot water blanched and non-blanched cocoyam leaf puree samples

Sample	L	a	b	h	C	E
SB	41.90±1.35^{a}	-1.51±0.11^{a}	3.86±0.31^{a}	291.37^{o}	4.15	54.81
HWB	35.61±0.02^{b}	-6.03±0.16^{b}	5.17±0.13^{b}	319.39^{o}	7.94	61.44
Control	47.26±1.09^{c}	-10.00±0.13^{c}	11.48±0.45^{c}	311.06^{o}	15.23	51.56

L, lightness; a, red/green; b, yellow/blue; h, hue; C, chroma; E, total colour difference; SB, steam blanched; HWB, hot water blanched

Mean of triplicates of each sample±standard deviation (SD).

Different superscripts indicate significant difference amongst values within each column ($p \leq 0.05$).

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Sensory properties of soups produced using cocoyam leaf puree

The mean sensory acceptability scores were 4.96 and above on a 9-point hedonic scale where 1=dislike extremely, 5=neither like nor dislike and 9=like extremely. The results from the sensory evaluation of soups produced revealed that there was no significant difference between soups prepared using hot water blanched puree stored for five days and from control (traditionally prepared puree) in terms of all the attributes. There was however a significant difference between soups from steam blanched purees and hot water blanched puree stored for five days.

Colour: The colour appearance of any food product is usually one of the first attributes encountered and according to Al-Subhi,[16] has an influence on consumer perception of food by evoking an initial response from the consumer. The soups from hot water blanched puree stored for five days and control sample had a slightly brownish colour while soups from the steam blanched puree samples had a slightly greener colour. In terms of colour, soups from the control sample and the hot water blanched puree sample stored for five days were the most preferred with scores of 5.72 and 6.26 respectively as shown in (Table 3). The soup from hot water blanched puree sample stored for a day scored the lowest 5.20 in terms of colour. Similar scores were recorded in Table 3 for soups from steam blanched puree stored for a day 5.50 and steam blanched puree stored for five days 5.60. The trend of preference could be due to the fact that the soups from hot water blanched puree stored for five days and control sample had a slightly brownish colour which was similar to the traditional "ebunuebunu" soup most panelists were familiar with. The brownish colour could be due to the longer boiling time of the cocoyam leaves in the traditional soup preparation and also the browning onset in the hot water blanched puree stored for five days.

Results from Table 3 show that the control sample and the hot water blanched puree sample stored for five days were the most preferred in terms of aroma, mouth feel, consistency, taste, thickness and even overall acceptability. This could be because the control sample and the hot water blanched puree sample stored for five days had the most preferred colour, which according to,[16] is usually one of the first attributes of any food product encountered and has an influence on consumer perception of food by evoking an initial response from the consumer.

Table 3 Effects of steam and hot water blanching on sensory attributes of soup made from cocoyam leaf puree

Attribute	HWB 1 day	SB 1 day	HWB 5 days	SB 5 days	Control
Aroma	5.08^{a}	4.76^{a}	6.26^{b}	4.98^{a}	6.22^{b}
Colour	5.20^{a}	5.50^{a}	6.26^{b}	5.60^{2a}	5.72^{b}
Mouthfeel	4.64^{a}	5.00^{a}	6.64^{b}	4.98^{a}	6.30^{b}
Consistency	5.22^{a}	5.56^{a}	6.46^{b}	5.38^{a}	6.10^{b}
Taste	4.76^{a}	4.64^{a}	6.32^{b}	4.66^{a}	6.58^{b}
Thickness	4.58^{a}	5.22^{a}	6.38^{b}	5.12^{a}	5.78^{a}
Overall acceptability	4.96^{a}	4.98^{a}	6.46^{b}	5.20^{a}	6.54^{b}

HWB, hot water blanched; SB, steam blanched

Different superscripts indicate significant difference amongst values within each row ($p \leq 0.05$).

Conclusion

The results obtained from the study showed that both steam blanching and hot water blanching methods caused significant changes in the colour, pH, TSS and Flow of cocoyam leaf puree. Steam blanching method caused a more significant reduction in the green colour of the puree than hot water blanching method at $p < 0.05$. Purees from both hot water and steam blanching methods in soups are acceptable to the consumer although hot water blanching gives a more acceptable product than steam blanching.

Acknowledgements

None.

Conflict of interest

The author declares no conflict of interest.

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Citation: Quarcoo PC, Wireko-Manu FD. The effect of steam and hot water blanching on some quality attributes of cocoyam leaf. *MOJ Food Process Technol.* 2016;2(5):164–168. DOI: 10.15406/mojfpt.2016.02.00050