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The Use of Steam Blanching for Preserving the Quality of Kolanuts (*Cola nitida*)

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ABSTRACT

Steam-blanching of kolanuts (C. nitida) *was considered in this study as a possible primary process step, prior to their storage, for preventing the undesirable action of polyphenolase enzymes caused by surface injury during post-harvest handling, and thus preserving the aesthetic quality of the nuts especially in terms of colour and freshness. The sensory qualities of both red and white nuts of* C. nitida, *steam-blanched under different time–temperature combinations, especially in terms of colour and texture, were evaluated by numerical scaling. Weight changes due to moisture loss during blanching were also observed, while absorbance readings were measured spectrophotometrically as an index of oxidation of kolanin in the blanched nuts under the different conditions. Results obtained indicate that steam blanching may be used to control this enzymic process. However, the higher the blanching temperature, the greater the change observed in the texture and surface coloration of the nuts. Above 108·5°C white nuts turned slightly or very dull grey, while red nuts changed to dull greyish–pink or dull grey with no internal brown ring formation on injury in both cases. Blanching time was also found to affect both the colour and texture of the nuts while heat penetration, being dependent on nut size and weight, appeared to control the rate of enzyme inactivation. Based on these results, an optimum time–temperature combination of 108·5°C for 10 s is suggested to be suitable for enzyme inactivation during post-harvest processing of kolanuts.*

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INTRODUCTION

Kolanuts are the bitter, astringent nuts of the tropical tree crop (*Cola nitida*), belonging to the family Sterculiaceae. They derive their importance and acceptability for human consumption, not from their food value, but solely from their tonic effects and use as a masticatory depending on the alkaloid content (Eijnatten, 1966), as well as their characteristic sensory qualities. Thus the most important commercial factors for acceptability are nut size, colour, texture and keeping quality. In recent times, these nuts have assumed an importance in the preparation of caffeine for the pharmaceutical industry (Eijnatten, 1966; Somorin, 1972) and as a constituent of many kola-flavoured drinks and wines (Beattie, 1970; Ogutuga, 1975; Ogunmoyela & Famuyiwa, 1982). In dried form, they have also been successfully incorporated into novel chocolate products termed 'kola chocolate' (Ogutuga & Williams, 1975). Nigeria is the world's largest producer of these nuts, the bulk of which are consumed fresh. The plump and fresh appearance of the nuts results from the high moisture content, usually about 50–70% (Ogutuga & Daramola, 1975; Ogunmoyela, 1983), since on injury, the nuts readily brown and dry out, becoming rock-hard and unacceptable. This therefore requires that the nuts be processed, cured and stored in such a way that they retain their plumpness for all-year-round consumption. This post-harvest handling of the nut, which is usually embedded in a pod with an outer skin or testa, is thus a delicate process because of the ease of browning and the attendant effects on the quality and storability of the nut. In fact, rapid quality deterioration due to enzymic browning is a phenomenon associated with high losses of kolanuts in Nigeria. On injury and subsequent exposure to handling, the undesirable brown pigmentation produced, accompanied by rapid desiccation, causes a significant reduction in the quality and storability of the nut. It is also known that the fresh nuts lose their original colour and physiological action on drying (Beattie, 1970). This is believed to be due to the presence of an unstable kolatin-caffeine glycoside which is readily oxidised and hydrolysed as a result of the action of enzymes to form kola red and free caffeine (Eijnatten, 1966), and it has been suggested that heat treatment prior to drying would ensure retention of the original colour and physiological action. However, previous studies in the literature have not been aimed at quantitatively determining the effects of blanching on the sensory quality of the nuts as well as optimum conditions of blanching, because of this delicate nature.

This paper, therefore, is an attempt to evaluate the effectiveness of blanching as a technique for preventing the characteristic but undesirable browning, avoiding high storage losses and preserving the original colour, texture and flavour of the nuts. The quality of *Cola nitida* following blanching, and the optimum conditions of blanching which will allow for the maximum possible retention of consumer appeal, are also evaluated.

MATERIALS AND METHODS

Sources of samples

The kolanuts (*C. nitida*) used in this study were obtained directly from the experimental kola plots of the Cocoa Research Institute of Nigeria, Headquarters, Idi-Ayunre, Ibadan, in a completely fresh condition, wholly embedded in their pods.

The pods were cut open with a sharp knife and the nuts carefully separated whole, without any surface injury, from the husk and testa. Both red and white nuts of this variety were used.

Steam blanching experiments

Initial trials were carried out using kolanuts of indeterminate storage period and condition purchased directly from the local Wurukum market, Makurdi, Nigeria. These blanching trials showed that steam blanching produced better results, especially in terms of the aesthetically important nut colour, than atmospheric water blanching of the nuts. Thus whole and split nuts were weighed before steam blanching in an automatic pressure cooker (Prestige Group plc, Derby, United Kingdom) at three different temperatures of 108·5°C, 115·3°C and 121°C, respectively, regulated by pressure control. The corresponding pressure levels at these temperatures were 143·3 kN/m^2, 169·1 kN/m^2 and 198·5 kN/m^2, respectively, attained by using different weights. The weighed nuts were placed on the trivet inside the pressure cooker but not in contact with the water and the lid firmly secured in place. Blanching times were recorded with a stop clock after the come-up time when the desired temperature had been reached as indicated by the characteristic hissing noise.

After blanching, the nuts were allowed to cool and then reweighed. For each blanching temperature, the blanching times were varied and the changes in weight of the nuts recorded. The blanched nuts were then cut straight through the middle and, for each treatment, the nuts were observed for surface coloration changes while the intensity of the brown ring formed was observed where appropriate.

Sensory characteristics of blanched nuts

Colour and texture were selected to be the most important sensory quality factors by a carefully selected semi-trained sensory panel of six, comprising, mostly, regular kola consumers. Textural parameters of importance consisted of firmness, crispness (on breaking) and crunchiness and these were assessed on a 0–9 numerical–descriptive scale (Ogunmoyela & Birch, 1984) using the fresh red and white nuts as the control. Thus 0 was taken to represent extremely firm, crisp and crunchy texture while 9 was taken to represent extremely soft with complete loss of firmness, crispness and crunchiness.

For colour, 0 was taken as no brown coloration developed while 9 represented an extremely intense brown coloration developed internally, as well as surface coloration changes compared with fresh kolanut samples as controls. Colour was assessed by slicing through the blanched nuts and visually observing the formation of a brown ring after *five* seconds, while texture was assessed by exerting pressure on the nuts placed between the thumb and index finger of the right hand to test for firmness and subsequently when crushed and chewed in the mouth, held between premolars.

Spectrophotometric determination of pigmentation changes

Five grams of steam-blanched samples were taken and crushed in a mortar with a pestle, before homogenising in 2N HCl. The homogenate was filtered and the filtrate diluted by taking 1 ml and making up to 10 ml with 2N HCl to allow the absorbance to be read within the range of the spectrophotometer scale. The absorbance readings of the diluted homogenates were taken at 450 mm (Osagie & Opoku, 1984) on a Spectronic 21 visible spectrophotometer, as an index of oxidation of the pigment.

RESULTS AND DISCUSSION

The primary objective of blanching is to reduce enzymic activity to a level at which there is no noticeable change in the product during subsequent handling and injury, or at which any such change may not be readily detected (Mitchell & Rutledge, 1973). In this study, the most visible changes in the blanched kolanuts were found to be in weight, colour and texture.

Weight changes due to moisture loss in nuts

Figure 1(a, b) shows histogram plots of percentage weight losses in red and white kolanuts after steam-blanching under different time–temperature combinations. The changes indicate moisture losses after blanching, in both cases this evidently increasing with time at a particular temperature. This is not surprising because of the high moisture content of the freshly harvested

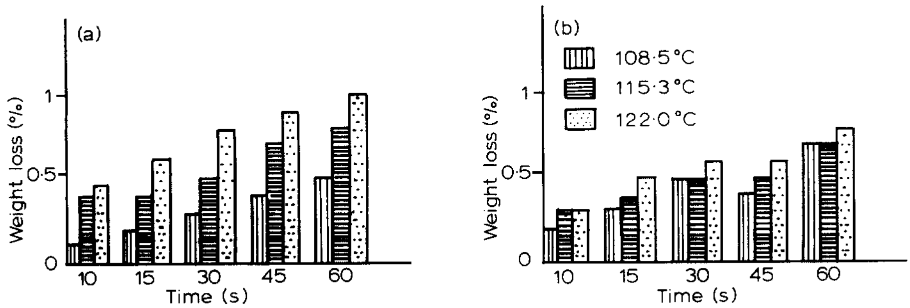

Fig. 1. Weight losses of kolanuts during steam blanching at different time–temperature combinations for (a) red nuts, (b) white nuts.

nuts (Ogutuga, 1975) since only approximately one-third of the nut consists of dry matter. Thus moisture loss in the form of water vapour, owing to the use of high temperatures, would improve storability of the nuts since it has been reported that the greatest moisture loss occurs during the first two weeks after harvesting and processing of the nuts and this initial rapid moisture loss is believed to normally govern the success of subsequent storage (Ogutuga & Daramola, 1975). However, the moisture loss appeared to be dependent on the time and temperature of blanching. Since at lower blanching times and temperatures, heat penetration into the tissues would be slower, it was evident, from the formation of a brown ring internally, that inactivation of enzymes deep in the tissues was incomplete at lower time–temperature combinations. However, at higher time–temperature combinations, there was clear evidence of texture changes in the nuts although the enzymes had now been completely destroyed since no brown ring was formed. Hence an optimum combination of time and temperature must be that which will cause the desirable losses in moisture while retaining the delicate sensory attributes.

Effect of steam blanching on colour and texture

Betanin, which is the chief red pigment of beetroot (Harmer, 1980), has been found to be the main pigment in kolanuts. It has been suggested that this pigment may serve the same purposes an anthocyanins in other plant families (Morris, 1951). According to Elbe *et al.* (1974), heating betanin solutions causes the red colour to diminish and eventually fade to light brown. Hence it is not surprising that time and temperature of blanching produced variable effects on sensory qualities of kolanuts, especially colour and texture. Results in Table 1 show the effects of steam-blanching on colour and texture. Softer texture was recorded at the higher time–temperature combinations. While no browning was detected in the kolanuts blanched at higher time–temperatures, a dull surface coloration was observed both in the

TABLE 1
Sensory Changes (Colour and Texture) Observed in Steam Blanched Kolanuts at Different Time–Temperature Combinations

Blanching time (s)	*White kolanuts*									*Red kolanuts*								
	Texture			*Colour (brown-ring)*			*Surface coloration*			*Texture*			*Colour (brown-ring)*			*Surface coloration*		
	A	*B*	*C*	*A*	*B*	*C*	*A*	*B*	*C*	*A*	*B*	*C*	*A*	*B*	*C*	*A*	*B*	*C*
10	1	3	5	1	1	0	Normal	Normal	Normal	1	2	4	1	1	0	Normal	Normal	Slightly pink–red
15	2	5	6	1	0	0	Normal	Normal	Slightly grey	3	4	6	1	0	0	Normal	Normal	Slightly pink–red
30	5	6	7	0	0	0	Slight grey	Slight grey	Dull grey	4	5	7	0	0	0	Pink–red	Pink–red	Greyish-pink
45	6	7	8	0	0	0	Dull grey	Dull grey	Very dull grey	5	6	8	0	0	0	Pink–red	Greyish-pink	Greyish-pink
60	7	8	9	0	0	0	Very dull grey	Very dull grey	Very dull grey	6	7	9	0	0	0	Greyish-pink	Dull grey	Dull grey

A = Nuts steam blanched at 108·5°C.
B = Nuts steam blanched at 115·3°C.
C = Nuts steam blanched at 122·0°C.
Colour and texture measured on 0–9 scale (for colour, 0 = no browning at all after 5 s and 9 = intense brown coloration after 5 s; for texture, 0 = extremely firm and crunchy and 9 = extremely soft with no snap or crunchiness).

white and red nuts, showing the effects of the heating medium on the pigment.

From the histogram plots in Fig. 2(a, b), it would appear that there were slight increases in colour, even for the white nuts, which, unlike the texture, were not detectable by the panelists, but only by spectrophotometry. The results thus seem to indicate that texture is a much more discernible sensory attribute than colour to kolanut esters, probably because kolanuts of different colours occur naturally. However, as is evident from Table 1, changes in surface coloration of the red nuts detectable by the panelists were more profound, since different degrees of dullness of the red colour were obtained under different blanching time–temperature combinations.

Since betanins are known to be most stable at pH 4·5 (Harmer, 1980), the undesirable changes in the colour of blanched kolanuts may be prevented by using a blanching medium at this pH. Panelists found that both red and white kolanuts steam blanched at 108·5°C for 10 s retained a firm and crunchy texture with the resulting surface colorations comparing favourably with those of the fresh samples. However, at higher temperature–time combinations, the nuts turned soft and sometimes soggy with the surface colorations profoundly changed. Since no intense brown rings were observed in nuts blanched at 108·5°C for 10 s, this may be suggested to be a suitable time–temperature combination for controlling the undesirable effects of browning, as already outlined. However, given the instability of natural colours (Joslyn, 1970), inclusion of the blanching process in the post-harvest handling may require the use of pH-controlled solutions. Also, since red kolanuts are much more commonly available, with varying natural shades of red and pink occurring naturally and under different storage conditions, it is not anticipated that these slight coloration changes will reduce the acceptability of the nuts amongst kolanut consumers so long as the textural characteristics are unchanged by such treatment, given the added advantage of prolonged shelf-life.

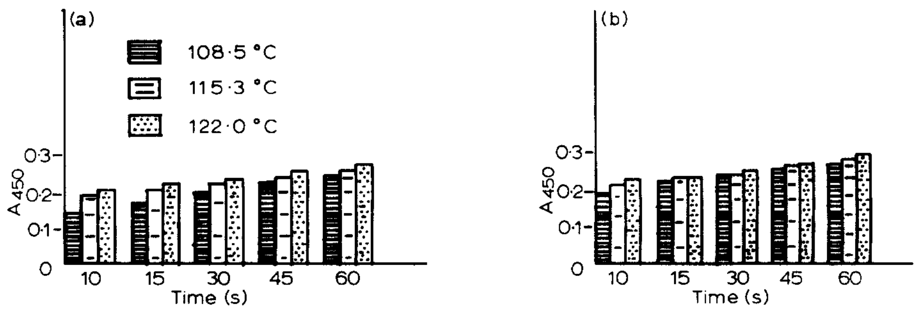

Fig. 2. Changes in absorbance (A_{450}) of kolanuts after blanching at different time–temperature combinations for (a) white nuts, (b) red nuts.

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