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Towards the development of sweet potato-based couscous for human consumption in Benin

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Sweet potato processing and consumption patterns are very limited in Benin. The present study aimed to suggest a new utilization of the crop as food. Roots from a white flesh variety were processed into flour and later into couscous. This couscous was steam-cooked following the same procedure as a wheat-based couscous purchased in market. The foods obtained were submitted to panellists' appreciation. Although significant differences were observed between wheat-based couscous and sweet potato-based couscous regarding the colour and the flavour, the mean score obtained by the later couscous showed that the product was acceptable to good sensory quality.

Key words: Sweet potato, couscous, sensory quality.

INTRODUCTION

Roots and tubers ranked second food crops after cereals, particularly under tropics (Scott et al., 2000; Chandra, 2012). Among these roots and tubers, sweet potato (*Ipomea batatas* [L.] Lam.) has the highest productivity in terms of dry matter, energy and vitamins supply (Bell and Gochenaur, 2006). The Food and Agriculture Organization (FAO) of the United Nations recognized that sweet potato ranked third among root and tubers harvested in the world. Thus, during 2012 year, 108,004,174 tons of sweet potatoes were harvested over the world, with 4,638,664 tons in West Africa (FAO, 2014). Since sweet potato roots are highly perishable, there is a need to process them after harvesting with the purpose of reducing or avoiding wastes.

In Benin, sweet potato contributes to food security for poor families, particularly during lean days. According to FAO (2014) about 70,000 tons were harvested during 2012. Despite its contribution, the crop is still barely considered in the national agricultural development policies.

Sweet potato is processed in various ways over the world. In India, Singh et al. (2004) used sweet potato flour for the development of a pasta product. Processing of dry noodles based on wheat-sweet potato composite flour were experimented by Zhang et al. (2010). In Malaysia, a sweet potato based dessert known as *bubur caca* is consumed (Anonymous, 2011). Candied sweet potato and sweet potato pie are traditional dishes

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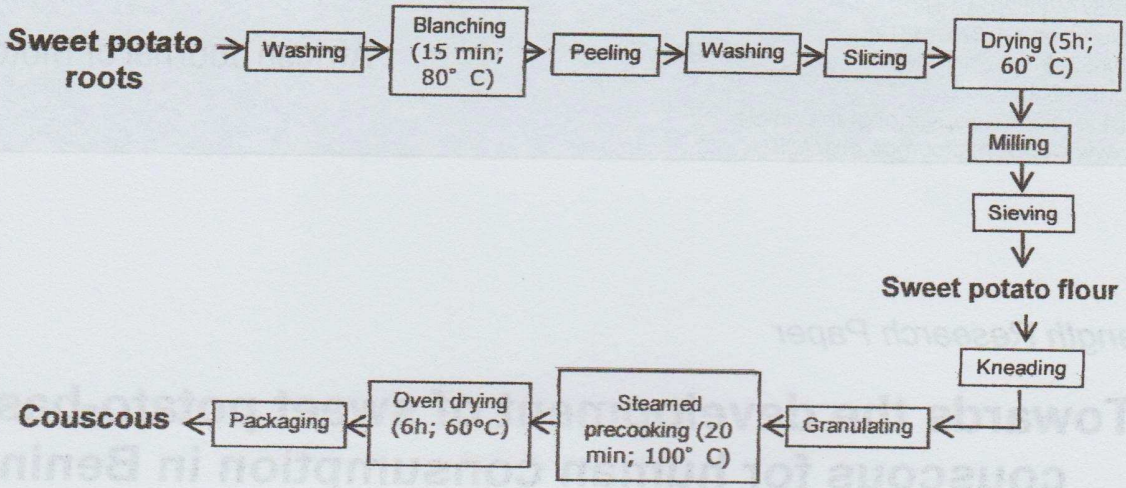

Figure 1. Flow diagram of the processing of sweet potato couscous.

consumed in northern America (Anonymous, 2011). Oke and Workneh, (2013) reported the processing of sweet potato into chips or flour for use in bread and cakes making, and its processing into fermented and dried products like fufu in Africa. However, sweet potato processing and consumption patterns are very limited in Benin; that may be the basis of the little interest in this crop. The few processing patterns consist in boiling, roasting or frying of sweet potato. Sometimes the boiled roots are spiced and crushed into a purée. Since the imported wheaten products such as flour, pasta, couscous, etc. are popular on Benin's local markets, and Katan and De Ros (2004) suggested the utilization of indigenous crops such as sweet potato to reduce the importation of wheat and wheaten products in countries where wheat production is disadvantaged,this preliminary study suggested a new utilization of sweet potato through its processing into a couscous for both urban and rural consumers.

MATERIALS AND METHODS

Raw material and processing method

The white fleshed variety of sweet potato was purchased from a local market and used during the present study. The processing was carried out in triplicates and followed the procedure summarized in Figure 1. For each repetition, about 4 000 g (Mettler Toledo SB16000, Switzerland) of sweet potato roots were processed.

Conversion rates calculation

During the processing, products obtained from the raw material to the end product were weighted and finally the conversion rates of sweet potato roots-flour and sweet potato roots-couscous were calculated by doing the ratio of the weight of the product by the initial weight of sweet potato roots.

Water content determination

Water contents were assessed using the AOAC (2012) methods. Briefly, 5 g sample of fresh sweet potato and its derivatives (flour and couscous) were oven-dried at 105°C for 48 and 24 h, respectively. The evaporated water amount was used to calculate the water contents.

Sensory evaluation

Couscous from sweet potato was steam-cooked and submitted to 30 untrained consumer's appreciation in comparison with a conventional wheat-based couscous SIPA (PASTACORPS, 180 rue Descartes, France) purchased in a local market. The paired comparison test was used according to the standard 5495: 2005 of the International Organization for Standardization (2010). Comparison was based on colour, taste, texture and flavour of the cooked sweet potato- and wheat-based couscous. Sensory attributes were rated on a 5-point scale going from 1 = unpleasant to 5 = very good.

Statistical analysis

Data were analysed using SPSS 16.0 software (SPSS Inc., Chicago, Illinois, USA). For each sensory attribute the mean score was calculated separately for sweet potato couscous and wheat-based couscous and compared using Student's T-test.

RESULTS AND DISCUSSION

The processing experiment led to obtaining dry flour and later, dry couscous granules. The technological parameters of the processing are summarized in the Table 1.

It appeared from Table 1 that the conversion rate of

Table 1. Technological parameters of the processing of sweet potato roots into couscous.

Parameter	Sweet potato roots	Sweet potato flour	Sweet potato couscous
Initial weight (g)	4,000 ± 3.21	1,263 ± 88.48	2,020 ± 23.12
Conversion rate (%)	-	31.6 ± 2.2	50.5 ± 0.5
Water content (%)	65.08 ± 0.81	5.41 ± 0.67	10.84 ± 0.75

Results given as averages of triplicate determinations ± S.D.

Table 2. Sensory evaluation results analysis using Student T-test.

Sensory parameter	Paired samples statistics†		Paired samples test			
	Wheat couscous (WC) mean score	Sweet potato couscous (SPC) mean score	95% confidence interval of the difference		t value	Significance
			Lower	Upper		
Colour	4.30 ± 0.70	3.37 ± 1.13	0.415	1.452	3.683	0.001**
Taste	4.17 ± 0.79	3.40 ± 1.28	0.157	1.377	2.571	0.016*
Texture	3.87 ± 1.01	3.57 ± 1.17	-0.265	0.865	1.087	0.286
Flavour	4.10 ± 0.96	3.70 ± 1.24	-0.248	1.048	1.263	0.216

†Results given as averages of 30 determinations ± S.D, **Highly significant, * Significant.

sweet potato roots into flour was about 30% while the conversion rate of sweet potato roots into couscous reached about 50%. This is probably due to the water content of the couscous (10.84%) which was almost 2 times higher than the water content of the flour (5.41%). However, the water content of the processed sweet potato couscous was lower than the maximum threshold of 13.5% requested by the Codex Alimentarius for wheat-based couscous (FAO/WHO, 1995). This ensured the storability of the sweet potato couscous processed in this study.

After steam-cooking, the sweet potato couscous darkened compared to the wheat-based couscous. The difference in colour was evidenced by panellists who detected significant difference (P<5%) between the sweet potato couscous and the wheat couscous regarding their colour and their flavour (Table 2). This phenomenon is similar to the "after cooking darkening" (ACD) of potato resulting from the oxidation of the ferri-chlorogenic acid in the boiled or fried potatoes (Wang-Pruski and Nowak, 2004). The browning of sweet potato products during heat processing was long ago reported by Scott et al. (1944) as the consequence of polyphenol oxidase reaction with tannins when the roots is subjected to tem-peratures not high enough to denature the enzymes. This finding was later confirmed by Ma et al. (1992) who reported that instead of inactivating them, insufficient heat treatment accelerated enzymes activity in sweet potato.

Even though ACD has not any effect on the nutritional value of the food, it was reported as the most widespread undesirable tubers traits (Wang-Pruski and Nowak, 2004). Krishnan et al. (2010) suggested soaking of sweet potato slices in 1.00% acetic acid for 1 h to obtain flour with low browning index. Further investigations will determine methods to be used to avoid the darkening phenomenon during the sweet potato couscous cooking. Both couscous were considered similar (P>5%) as far as the taste and the texture were concerned.

Although significant differences were detected between the processed sweet potato couscous and the wheat-based couscous, more than 50% of panellists considered sweet potato couscous as good to very good for all the sensory attributes tested (Figure 2), showing that the product might be accepted by Benin consumers.

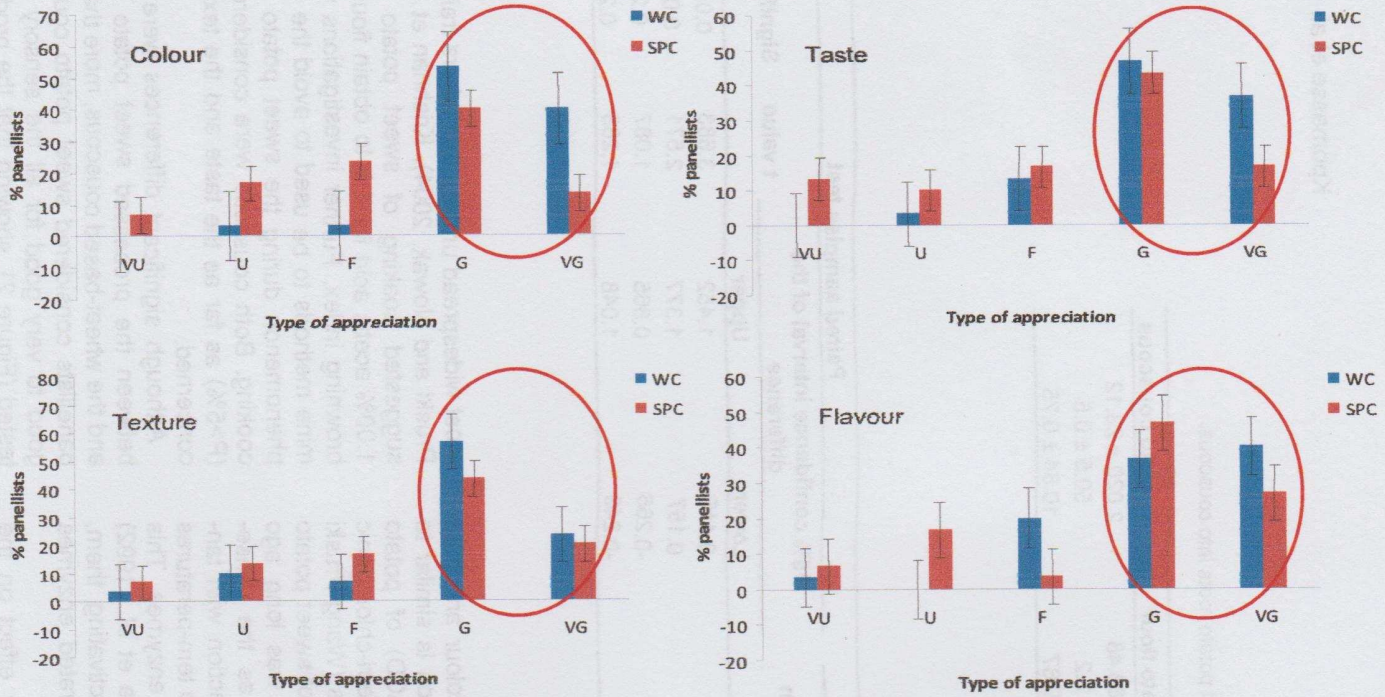

Figure 2. Sensory evaluation results: Distribution of panellists according to their appreciation of the couscous per sensory parameter. VU= very unpleasant; U= unpleasant; F= fair; G = good; VG= very good; (■) WC= wheat couscous; (■) SPC = sweet potato couscous.

Conclusion

The study shows the potential of sweet potato to be used in couscous production. Since Benin is one of the West African countries targeted by the Sweetpotato for Profit and Health Initiative (SPHI) which goal is to "enhance the lives of 10 millions households in 16 Sub-Saharan Africa countries by 2020 through the effective and diversified use of sweet potato" (http://www.sweetpotatoknowledge.org, 2014), this study opens an interesting perspective for sweet potato utilisation, particularly the orange fleshed sweet potato (OFSP) which introduction is in progress in Benin.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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