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Physicochemical and Functional Properties of Raw and Pre-treated Anchote (*Coccinia abyssinica (Lam.) Cogn.*) Tuber Flours Dried at Different Temperatures

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Abstract

The transformation of agricultural outputs into semi-processed and processed food materials is one of the current scientific demands. There might be changes in original property and composition of the product during processing. As part of this concern, physicochemical and functional properties of raw and pre-treated (blanched and boiled) anchote (*Coccinia abyssinica (Lam.) Cogn.*) tuber flours prepared by drying at different temperatures (60, 80, 100 °C) were evaluated. Anchote is a potentially productive and nutritious starchy tuberous crop indigenous to Ethiopia. A factorial experiment in a completely randomized design was employed to run the experiment. Ranges of the results for pH, total soluble solids (TSS), water absorption capacity (WAC), oil absorption capacity (OAC), water absorption index (WAI), water solubility index (WSI), swelling power (SP), foaming capacity (FC), foam stability (FS), total polyphenol content, and total flavonoid content were 5.70-6.47, 5.37-10.8 °Brix, 2.42-4.21 g/g,, 0.94-1.44 g/g, 3.40-5.42 g/g, 11.40-20.37%, 4.56-7.20 g/g, 3.31-33.33%, 1.89-20.00%, 0.22-0.80 mg GAE/g, and 0.12-0.44 mg CE/g, respectively. The results showed that both pre-treatment and drying temperature significantly ($p<0.05$) affected the pH, TSS, WAC, OAC, WAI, WSI, SP, TPC and TFC of the flours. The pH, TSS, WAC, WAI, WSI and SP were higher in the flour prepared from boiled anchote dried at lower temperature; while OAC, FC and FS were higher in the flour obtained from the raw tuber. The flour obtained from blanched and boiled anchote dried at lower temperature exhibited better functional property relative to the raw. Therefore, this value-added product could be used as a thickener and to improve texture compared to the flour made from the raw anchote in food formulations.

Keywords: Anchote flour; Drying temperature; Functional properties; Physicochemical properties; Pre-treatment

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Introduction

Anchote (*Coccinia Abyssinica (Lam.) Cogn.*) is a productive and nutritious starchy tuberous crop indigenous to Ethiopia. The crop contains higher nutrients such as carbohydrate, protein, fiber, and minerals compared to other common root and tuber crops (Parmar et al., 2017; Ayalew, 2016). The tuber is unique in its high protein and calcium contents, which are usually low in tuberous crops. However, it is underutilized crop due to limited processing and value addition except the traditional boiling of the tuber (Parmar et al., 2017). This limitation hindered its extensive utilization in different forms at different parts of the country. Converting the tuber into semi-processed products like flour is necessary for wider utilization, convenience and commercialization because of its perishable nature. The effect of drying temperature and pre-drying treatments on the nutritional composition and thermal properties of anchote flour was evaluated by Bikila et al. (2020). However, physicochemical and functional properties of the flour are not studied so far. Characterization of these properties is crucial if one plans to use it for different purposes. Therefore, this study was aimed to investigate effect of pre-drying treatments and drying temperature on physicochemical and functional properties of anchote tuber flour.

Materials and Methods

The improved variety anchote tuber (*Desta 01*) was used for this study. A 3*3 factorial experiment in completely randomized design was employed; pre-drying treatments in three levels (untreated (raw), blanched, boiled tubers) and drying temperature in three levels (60, 80, and 100°C) each replicated three times. Fresh tuber was washed using tap water, peeled, and sliced (~2 mm). The homogenized sample was grouped into three: raw, subjected to blanching in water (98±2ºC) for 5 minutes, and boiled in water for 30 minutes. The samples were dried in oven at temperatures of 60, 80, and 100°C. Dried tuber slices were ground into flour, sieved (500 μm mesh), and packed in polyethylene bag. Finally, the physicochemical and functional properties of the anchote flours were determined using their respective well established methods.

Results and Discussion

The pre-treatments (blanching and boiling) and drying temperature significantly ($p<0.05$) affected pH, TSS, WAC, OAC, WAI, WSI, SP, FC and FS of anchote flours (Table 1). The boiled flour dried at 60°C with relatively higher pH could be better used as industrial material for formulation of food products (Tortoe et al., 2017). Pre-treatments increased TSS, WAC, WAI, WSI, SP, FC and FS. The increase in TSS might be due to starch breakdown into soluble molecules (Thriveni et al., 2019). On the other hand, the increase in drying temperature reduced

TSS, WAC, FC and FS. The decrease in WAC may be due to damage of starch granules and denaturation of protein (Osobie et al., 2013). The boiled flour with higher WAC could be better used to formulate baby foods and bakery products than the raw. The flour obtained from boiled anchote tuber with higher WAI could have a tendency to be gelatinized and well-cooked (Osibanjo et al., 2017). Generally, the result revealed that better functionality flour was obtained from boiled anchote tuber dried at lower temperature (60°C).

Table 1 Physicochemical and functional properties of raw, blanched and boiled anchote flour dried at different temperatures (*mean ± standard deviation*).

PT	DT (^{0}C)	pH	TSS (°Brix)	WAC (g/g)	OAC (g/g)	WAI (g/g)	WSI (%)	SP (g/g)	FC (%)	FS (%)
Raw	60	6.10 ±0.01^{b}	7.2 ±0.3^{c}	2.72 ±0.03^{f}	1.21 ±0.04^{b}	3.93 +0.13^{e}	13.23 ±0.75^{bcd}	4.99 ±0.47^{d}	33.33 ±3.05^{a}	20.00 ±0.89^{a}
	80	5.98 ±0.01^{cd}	5.8 ±0.2^{d}	2.68 ±0.07^{f}	1.44 ±0.15^{a}	3.91 ±0.06^{e}	13.75 ±0.29^{bc}	4.56 ±0.49^{f}	19.61 ±1.96^{b}	4.92 ±0.08^{b}
	100	5.81 ±0.01^{e}	5.4 ±0.2^{d}	2.42 ±0.03^{g}	1.52 ±0.02^{a}	3.40 ±0.13^{f}	11.40 ±0.90^{d}	5.24 ±0.03^{d}	7.29 ±0.62^{c}	2.47 ±1.07^{b}
Blanched	60	5.97 ±0.02^{cd}	10.8 ±0.2^{a}	3.63 ±0.08^{b}	1.19 ±0.00^{bc}	4.94 ±0.13^{b}	15.17 ±0.76^{b}	6.07 ±0.07^{c}	4.67 ±1.15^{c}	1.91 ±0.02^{b}
	80	5.82 ±0.01^{e}	7.2 ±0.2^{c}	3.35 ±0.02^{d}	1.17 ±0.02^{bc}	4.40 +0.16^{cd}	14.83 ±1.04^{b}	6.14 ±0.05^{c}	4.31 ±0.60^{c}	2.22 ±0.55^{b}
	100	6.02 ±0.01^{c}	6.8 ±0.2^{c}	3.15 ±0.09^{e}	1.07 ±0.08^{c}	4.14 ±0.07^{de}	13.92 ±0.38^{bc}	6.65 ±0.34^{b}	6.00 ±2.00^{c}	1.89 ±0.04^{b}
Boiled	60	6.46 ±0.01^{a}	9.2 ±0.6^{b}	4.21 ±0.06^{a}	1.09 ±0.03^{c}	5.42 ±0.04^{a}	20.37 ±1.48^{a}	6.81 ±0.24^{b}	7.33 ±1.15^{c}	2.48 ±1.06^{b}
	80	6.02 ±0.01^{c}	6.8 ±0.2^{c}	3.72 ±0.09^{b}	1.12 ±0.08^{bc}	4.65 ±0.35^{c}	13.33 ±0.58^{bcd}	7.20 ±0.03^{a}	6.00 ±2.00^{c}	1.89 ±0.04^{b}
	100	5.91 ±0.01^{d}	6.8 ±0.3^{c}	3.54 ±0.03^{bc}	0.94 ±0.13^{d}	4.38 ±0.05^{cd}	12.05 ±0.43^{cd}	6.61 ±0.27^{b}	3.31 ±1.13^{c}	2.55 ±1.06^{b}
LSD (0.05)		*0.07*	*0.74*	*0.10*	*0.10*	*0.42*	*2.20*	*0.36*	*5.17*	*4.16*
CV		*1.22*	*3.74*	*1.85*	*6.01*	*5.42*	*8.10*	*4.67*	*15.62*	*15.02*

Means shared the same letters in a column are not significantly different ($p<0.05$). PT= pre-treatment, DT= Drying temperature, WAC= Water Absorption Capacity, OAC =Oil Absorption Capacity, WAI= Water Absorption Index, WSI= Water Solubility Index, SP=Swelling Power, FC=Foaming Capacity, FS=Foam Stability, LSD=Least Significant Difference, CV=Coefficient of Variation

Both pre-drying treatment and drying temperature showed significant ($p<0.05$) impact on TPC and TFC of the flours (Figure 1). Higher TPC and TFC were observed in the flour obtained from raw anchote dried at 60°C. From this finding, it is possible to conclude that minimizing the impacts of pre-treatment and reducing drying temperature could contribute to retaining more TPC and TFC in anchote flour.

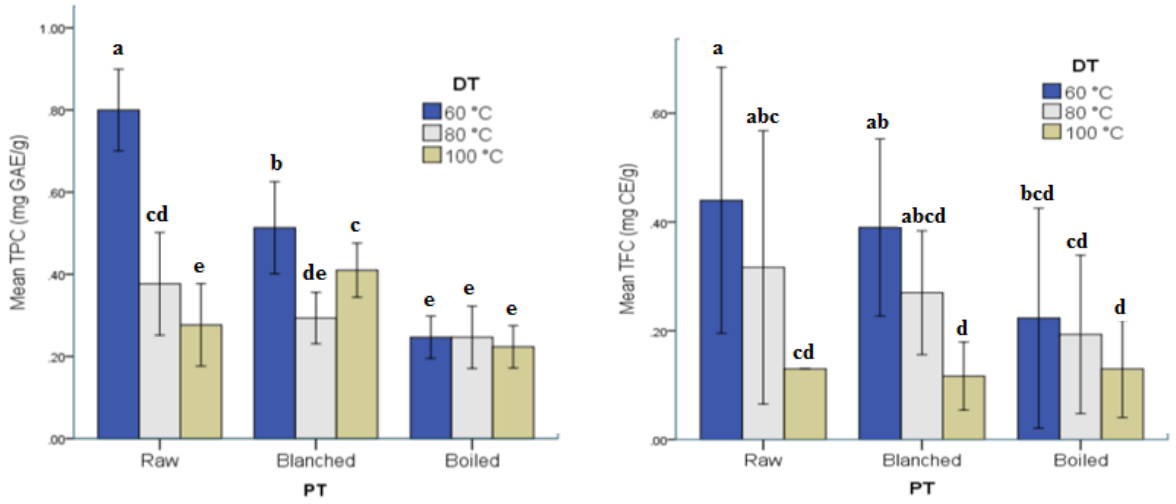

Figure 1 Effect of pre-treatments (PT) on total polyphenol content (TPC) and total flavonoid content (TFC) of anchote flour dried at different drying temperatures (DT)

Conclusions and Outlook

Both pre-drying treatments and drying temperatures exhibited an impact on physicochemical and functional properties of anchote flour. The raw tuber flour dried at a lower temperature (60°C) preserved better concentrations of TPC and TFC. But, from functional parameters point of view, anchote flour obtained from blanched or boiled tuber could be better used as a substitute for starch-based ingredients. For instance, it might be a potential raw material to be used as a thickener and to improve texture compared to the flour made from the raw tuber.

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