ANTINUTRIENTS COMPOSITION OF FOAM MAT DRIED BLACK PLUM POWDER

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Abstract
Antinutrients composition of foam mat dried black plum fruits were studied. Fresh black plum was washed with distilled water and sorted to remove bad ones. The edible portions of the plum were removed manually with a clean kitchen knife and the pulp collected in a sterile container. The mixture of the pulp, foaming agent (glycerol monostearate at 5-15%) and stabilizing agent (carboxymethyl cellulose at 3-5%) were whipped using a kitchen mixer for 30 min to subject it to foaming process and thereafter, spread on a stainless-steel tray and placed in a cabinet dryer for drying at different temperature (50 - 70°C), weighed at 30 min interval until a moisture content of less than 10% was achieved. After drying, the plum was scrapped from the tray, milled, sieved into powder and thereafter subjected to antinutrient analysis. The results obtained includes oxalate (9.19-13.30 mg/100g), phytate (4.87-7.01 mg/100g), tannin (5.74-7.92 mg/100g), saponin (5.77-8.66 mg/100g) cardiac glycoside (6.45-8.94 mg/100g). Sample not foam mat dried recorded a significant ($p \leq 0.05$) lower values than foam mat dried samples for all the antinutrient investigated. It could be concluded that foam mat drying at lower temperature does not have a positive effect on antinutrient composition of black plum powder except for sample foam mat dried at moderate temperature.

Keywords: Black plum, Foam mat drying, Foaming agent, Stabilizing, and Antinutrients

Introduction

Black-plum fruits (*Vitex doniana*) is a tree crop that thrives in tropical Africa savannah and open woodland areas that produces plum-like fruit that is sweet and edible (Adejumo *et al.*, 2013). The fruit can be eaten fresh or processed into jams, marmalades, prunes, juice or alcoholic beverages (Adejumo *et al.*, 2013). In Northern Nigeria, the leaves of the fruits are combined with groundnuts, salt and pepper to make *dinkin dinya* or candies *akwa* (Hassan and Shamsudeen, 2019). Black plum fruit is called *Ori ala* (Yoruba) *Udhakiri* (Igbo) *Dinyar* (Hausa) and *Ezu* (Ebira) (Hassan and Shamsudeen, 2019). Uchenna and Otu (2019) reported that black plums are good source of phytochemicals and nutritional components, while the leaves have been shown to have anti-malaria and anti-dysentery effects. The fruits contains varieties of minerals including iron, calcium, phosphorus, magnesium, manganese, fluorine, sulfur, potassium, and sugar as well as vitamins A, B1, B2, and C (Uchenna and Otu, 2019).

Drying is an important food processing operation that preserves raw food materials. During drying processes, the moisture content can be lowered to a level ranging from 1 to 5%, which stops or slow down the activity of microorganism and undesirable enzymatic (Zubair *et al.*, 2023). In addition to substantial reduction in weight and volume of the food product been dried, drying also minimizes packaging requirements, storage and transportation costs of food product (Zubair *et al.*, 2023). As drying process goes on, a new microstructure is formed which is crucial for the final product texture and general perception (Zubair *et al.*, 2023).

Foam mat drying is a technique in which liquid or semisolid food materials are converted into foam by incorporating air into it through whipping with the addition of an edible foaming agent and stabilizing the emulsion by adding a foam stabilizer (Abbasi and Azizpour, 2016). The process is simple, economical and time efficient in comparison to other drying processes (Abbasi and Azizpour, 2016). Formation of the foamed

structure increases liquid-gas interface accelerating dehydration at lower temperatures. Furthermore, a lower drying temperature preserves nutritional value while improving organoleptic properties and lowering the energy required for the drying process as a whole (Abbasi and Azizpour, 2016). Uchenna and Otu (2019) reported a high mineral content for foam mat dried papaya powder and a superior reconstitution property compared to papaya dried using conventional drying techniques. Adejumo *et al*, (2013) also reported stability in the vitamin C content and antioxidant composition of foam mat dried mango powder. The objective of the study is to determine the antinutrient composition of foam mat dried black plum subjected to different drying temperature, foaming agent and stabilizing agent concentration.

Materials and Method

Materials

Black plum fruits were obtained from Adu market, Ajaokuta local government, Kogi State, Nigeria. Glycerol monostearate (foaming agent) and carboxyl methyl cellulose (stabilizing agent) a product of Sim Company, Pulau Pinnang, Malaysia were sourced from Mekang Chemicals vendor, Ojota, Lagos State.

Sample preparation

The sample was prepared as described by Abbasi and Azizpour (2016). Fresh black plum was thoroughly with distilled water and the edible portions removed manually with a clean kitchen knife and the pulp was collected in a clean sterile container. The mixture of the pulp, foaming agent (glycerol monostearate at 5-15%) and stabilizing agent (carboxymethyl cellulose at 3-5%) were whipped using a kitchen mixer for 30 min to subject it to foaming process and thereafter, the foamed pulp were spread on a stainless-steel tray and placed in a cabinet dryer for drying at different temperature ranging from 50°C to 70°C, weighed at 30 minutes interval until a constant weight was achieved. After drying, the plum was scrapped from the tray, pulverized and sieve to get the powder. The samples were coded and subjected to analysis of antinutrients as described by AOAC (2012).

Sample not foam mat dried at temperature (90°C) = NFMD
Sample dried at temperature (70°C) foaming agent (15%) stabilizing agent (4%)= $T_{70}F_{15}S_4$
Sample dried at temperature (50°C) foaming agent (5%) stabilizing agent (4%)= $T_{50}F_5S_4$
Sample dried at temperature (60°C) foaming agent (5%) stabilizing agent (5%)= $T_{60}F_5S_5$
Sample dried at temperature (50°C) foaming agent (10%) stabilizing agent (3%)= $T_{50}F_{10}S_3$
Sample dried at temperature (50°C) foaming agent (15%) stabilizing agent (4%)= $T_{50}F_{15}S_4$
Sample dried at temperature (70°C) foaming agent (10%) stabilizing agent (3%)= $T_{70}F_{10}S_3$
Sample dried at temperature (60°C) foaming agent (15%) stabilizing agent (5%)= $T_{60}F_{15}S_5$
Sample dried at temperature (50°C) foaming agent (10%) stabilizing agent (5%)= $T_{50}F_{10}S_5$
Sample dried at temperature (70°C) foaming agent (10%) stabilizing agent (5%)= $T_{70}F_{10}S_5$
Sample dried at temperature (60°C) foaming agent (15%) stabilizing agent (3%)= $T_{60}F_{15}S_3$
Sample dried at temperature (70°C) foaming agent (5%) stabilizing agent (4%)= $T_{70}F_5S_4$
Sample dried at temperature (60°C) foaming agent (5%) stabilizing agent (3%)= $T_{60}F_5S_3$

Statistical analysis

The analyses were carried out in triplicates and data obtained were subjected to analysis of variance using version SPSS 21. Differences among the means of the measured parameters were separated by Duncan range test at 5% significant level.

Results and Discussion

The result of the antinutrient composition of foam mat dried black plum powder is presented in Table 1. There was a significant difference ($p<0.05$) in the antinutrients composition of the samples with the control that was not foam mat dried recording a significantly ($p<0.05$) lower value than the foam mat dried samples for all the antinutrients studied. In addition, it was equally observed that foam mat dried samples at temperature of 60°C and 70°C shows a considerably lower values of antinutrients than foam mat dried samples at 50°C. This could be as a result of the fact that high temperature of drying helps to reduce the level of antinutrients composition

of food product as reported by (Zubair *et al*., 2023). Also the lower values observed in the foam mat dried samples temperature of 60°C and 70°C when compared with samples dried at temperature of 50°C is probably due to the fact that drying rate of foamed samples is relatively high because of the huge surface exposed to ensuring fast moisture removal as caused by the collaboration of air bubbles into the foam during the foaming process which create room for more heat penetration and subsequently reduce the level of antinutrients in the samples (Abbasi and Azizpour, 2016). The value range of 9.19-13.30 mg/100g for oxalate 5.77-8.66 mg/100g saponin recoded is slightly higher than 10.64 and 5.31 reported by Nwosu *et al* (2023) for black plum juice. The high concentration of antinutritional compounds in foods beyond certain thresholds could bind or inhibit essential minerals such as Ca, Mg, Fe and Zn to form insoluble phytate salts, and protein thereby making them unavailable for absorption in the body (Nwosu *et al*., 2023). However, tannin brings its anti-nutritional influences especially in non- ruminants mostly by binding dietary proteins and digestive enzymes into complexes, which are not readily digestible (Uchenna and Out, 2019).

Table 1. Antinutrients composition of foam mat dried black plum powder

Samples	Oxalate (mg/100g)	Phytate (mg/100g)	Tanin (mg/100g)	Saponin (mg/100g)	Cardiac glycoside (mg/100g)
NFMD	9.19^{a}±0.14	4.87^{h}±0.09	5.74^{h}±0.25	5.77^{g}±0.28	6.45^{f}±0.03
$T_{70}F_{15}S_4$	9.99±0.01	5.04^{g}±0.02	6.17^{g}±0.01	5.91^{fg}±0.11	7.08^{e}±0.06
$T_{50}F_5S_4$	13.03^{b}±0.05	7.02^{a}±0.01	8.05^{a}±0.03	8.66^{a}±0.18	8.94^{a}±0.03
$T_{60}F_5S_5$	11.27^{d}±0.04	6.75^{b}±0.18	7.42^{bc}±0.00	7.34^{c}±0.02	8.09^{c}±0.12
$T_{50}F_{10}S_3$	12.15^{c}±0.07	7.01^{a}±0.02	7.92^{a}±0.08	8.51^{a}±0.05	8.69^{ab}±0.02
$T_{50}F_{15}S_4$	12.61^{c}±0.24	6.80^{b}±0.02	7.73^{b}±0.04	8.02^{b}±0.01	8.48^{b}±0.01
$T_{70}F_{10}S_3$	10.42^{g}±0.12	5.23^{fg}±0.01	6.24^{g}±0.04	6.03^{ef}±0.01	7.24^{de}±0.01
$T_{60}F_{15}S_5$	11.05^{de}±0.03	6.26^{d}±0.03	7.02^{cd}±0.01	7.01^{cd}±0.01	7.69^{cd}±0.50
$T_{50}F_{10}S_5$	12.61^{c}±0.15	6.94^{a}±0.05	7.91^{a}±0.06	8.16^{ab}±0.05	8.59^{ab}±0.05
$T_{70}F_{10}S_5$	10.76^{fg}±0.13	5.30^{fg}±0.02	6.44^{fg}±0.05	6.38^{de}±0.11	7.75^{cd}±0.23
$T_{60}F_{15}S_3$	13.30^{a}±0.23	6.44^{e}±0.02	7.32^{ab}±0.08	7.09^{cd}±0.10	7.91^{cd}±0.09
$T_{70}F_5S_4$	10.38^{g}±0.05	5.95^{e}±0.06	6.52^{f}±0.02	6.90^{d}±0.12	7.94^{cd}±0.08
$T_{60}F_5S_3$	11.81^{d}±0.03	6.79^{b}±0.01	7.54^{c}±0.02	7.98^{b}±0.00	8.49^{b}±0.14

Values are mean ± standard deviation of triplicate determinations. Means in the same column with different superscript are significantly different ($p<0.05$).

Keys:

T= Temperature of drying (°C); F= Foaming agent Concentration (%); S= Stabilizing agent Concentration (%)

NFMD = Not foam mat dried

Conclusion

The study showed that samples not foam mat dried at temperature of 90°C recorded a significantly lower level of the anti-nutrients studied than the foam mat dried samples, followed by foam dried samples at temperature of 70°C. It could be concluded that foam mat drying at lower temperature does not reduce the antinutrients composition considerably as compared to sample not foam mat dried at higher temperature.

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