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A DEHYDRATED PRODUCT FROM THE CULINARY HERB, SHADO BENI (*Eryngium foetidum* Linn.)

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ABSTRACT

In an attempt to develop a dehydrated product, the food flavouring herb *Eryngium foetidum* Linn. commonly called 'shado beni' or 'bhandhanya' in Trinidad and Tobago, was dried in a natural convection cabinet dryer at 35, 45, 55 and 65 °C. The effects of various pre-drying treatments on the quality of the herb at 55 °C were also studied: steam blanching, water blanching and magnesium carbonate blanching. Drying of the fresh herb at high temperatures, e.g. 55 and 65 °C, resulted in an undesirable colour change from the green, typical of the fresh herb, to olive-brown/brown. This was paralleled by a decline in the herb's volatile oil constituent from 0.276% d.b for fresh shado beni to 0.049 and 0.030% d.b for the herb dried at 55 and 65 °C respectively. Shado beni dried at 35 °C appeared olive-green with an oil content of 0.095% d.b. Loss of green colour was considerably reduced by blanching in either water or magnesium carbonate prior to drying at 55 °C. Compared to the unblanched dried herb, oil yield was unaffected by the pre-drying treatments investigated.

INTRODUCTION

Shado beni (*Eryngium foetidum* Linn.) also called 'bhandhanya' in Trinidad and Tobago, is a pungently scented, aromatic food flavouring herb that grows naturally throughout Trinidad and Tobago, the other Caribbean islands and continental tropical America (Morean, 1988). Some of the other common names of this herb in various countries are 'chadron benee' (Dominica), 'fitweed' (Guyana), 'coulante' or 'culantro' (Haiti) and 'cilantro' or 'culantro' (Latin America) (Morean, 1988).

There is little information on the processing of this unique herb which is currently exported in the fresh state from Trinidad and Tobago to Canada, New York and London. The fresh herb, like all green, leafy commodities wilts and undergoes a deteriorative colour change from green to brown so it must be air-freighted immediately after harvest. A possible alternative to the export of the fresh, green herb at a moisture content of 88% (wet basis) is the export of a dried, stable product. Dehydration, a simple method of preserving foods to extend their period of availability, has the added advantage of making handling, storage and distribution less difficult and more economical because of a reduction in weight and bulk.

In both herbs and spices quality is determined by typical aroma and Koller (1988) has reported on the negative effect of high drying temperatures on the aroma retention of sage and thyme. Loss of green colour is also reported to occur during the dehydration of green commodities (Morgan et al., 1945; Weits et al., 1970). The principal degradatory pathway of chlorophyll during the drying of green commodities by hot air is the replacement of its magnesium atom by hydrogen and the consequent formation of olive-brown pheophytins (Mackinney and Weast, 1940; Berset and Caniaux, 1983; Davidek et al., 1990). Acids present in the fresh material or formed during heat processing are the major factors responsible for the removal of the magnesium ion from the chlorophyll molecule (Davidek, 1990).

The necessity of blanching commodities for improved product quality prior to dehydration has been recognized since 1929. Two methods commonly practised are steam and water blanching. According to Mackinney and Weast (1940) and von Loesecke (1955), blanching is necessary to prevent the formation of off-flavours, odours and colours. Blanching however, is reported to result in some degree of chlorophyll degradation with the subsequent formation of pheophytin. The extent of chlorophyll degradation is related to the degree of blanching (Mackinney and Weast, 1940; Dutton et al., 1943). Peroxidase activity is widely used as an index of blanching as peroxidase is the most heat-stable enzyme found in horticultural commodities.

Considerable effort has been aimed at stabilizing the colour of green commodities during thermal processing. The most widely reported method for the prevention of pheophytin formation is the addition of alkalizing agents during processing, e.g. magnesium carbonate (Lioutas, 1989), ammonium carbonate and/or ammonium hydroxide (Eheart and Odland, 1973; Woolfe, 1979) and sodium carbonate (Kaur and Manjrekar, 1975).

This study was conducted to determine the effects of varying air drying temperatures and pre-drying treatments on the final product quality of shado beni dehydrated under natural convection conditions with the aim of developing a dehydrated product from this unique herb.

MATERIALS AND METHODS

Effect of temperature on the quality of dried shado beni

Fresh shado beni (12 kg) was chopped in approximately 10-mm strips using a Chuo Boeki Kaisha Forage Cutter Model No. FC13B operating at a speed of 850 rpm. The chopped herb was mixed and five samples, each weighing 1.8 kg, were kept in sealed polyethylene bags at 10 °C until required. Samples were individually dried at 35, 45, 55 and 65 °C in an electric, natural convection (Blue M Sabil-Therm gravity oven) drier to a moisture content of 10% (wet basis) Drying times ranged from 80 h for the herb at 35 °C to 5 h at 65 °C.

Freshly harvested shado beni as well as the dehydrated products were analyzed for pH, chlorophyll, pheophytin and essential oil contents. Analyses were carried out in duplicate and the resulting data analyzed by the analysis of variance method. For pH determination, 5 and 2-g samples of the fresh and dried herb (ground) respectively were blended with 40 ml of distilled water. Chlorophyll and pheophytin levels were evaluated by the spectrophotometric method of Vernon (1960) modified by Berset and Caniaux (1983). The oil contents of the fresh and dried herbs were determined according to the method of Pearson (1976).A 250-g sample was used for estimation of the initial oil content of the freshly harvested herb. The dried herb was ground in a Burr mill and the oil content of 100 g was evaluated.

Effect of pre-drying treatments on the quality of dried shado beni

The effect of various pre-drying treatments on the quality of shado beni dried at 55 °C was investigated. Pre-drying treatments evaluated were steam, water and alkali blanching. Blanch times were the minimum required for inactivation of the enzyme peroxidase and were pre-determined by the peroxidase test outlined by Greensmith (1971).

A 2-kg sample of the chopped herb was treated for 6 min at 96 °C in a cabinet type, steam blancher The steamed leaves were then cooled under ambient conditions (2°C) prior to drying in the gravity oven at 5°C. For water blanching, 2 kg of the chopped herb was 'quick-dipped' in water at 100 °C for 10 sec. The blanched herb was drained and allowed to cool before placing in the gravity oven set at 55 °C. For alkali blanching, 2 kg of the herb was immersed for 10 sec in 0.09% magnesium carbonate solution at 100 °C (40 : 1 ratio of water to herb) (Lioutas, 1989). The blanched herb was drained, allowed to cool and dried at 55 °C in the natural convection oven. A batch of the chopped, untreated herb was also placed in the gravity oven at 55 °C with this serving as the control. For all treatments, the herb was dried to 10% moisture content (wet basis) and both fresh and dried shado beni evaluated for pH, chlorophyll, pheophytin and essential oil contents as previously described. Drying times ranged from 9 h for the alkali and water-blanched herb to 18 h for the unblanched herb.

RESULTS AND DISCUSSION

Effect of temperature on the quality of dried shado beni

Colour, pigment and pH changes

Deleterious colour changes from green, typical of the freshly harvested shado beni to olive-green with signs of browning, to brown with traces of green occurred as the drying air temperature was increased from 35 to 65 °C. These undesirable changes in the colour of the herb reflected a significant decline ($P \leq 0.05$) in chlorophyll content (from an initial 1,209 mg/100 g DM for the freshly harvested herb). This was accompanied by extensive pheophytin formation (the brown pigment formed during the heat processing of green commodities), particularly at the higher air-drying temperatures of 55 and 65 °C. These changes paralleled a significant decline ($P \leq 0.001$) in pH from an initial value of 5.9 during dehydration (Table 1).

Shado beni dehydrated at 35 °C appeared olive-green with signs of browning. This reflected a 14.4% loss of its initial chlorophyll content and a pheophytin concentration of

460 mg/100 g DM. These changes in pigment concentrations of the dehydrated herb paralleled the decline in pH by 0.1 unit (value of 5.8). For shado beni dehydrated at 65 °C however, the pH declined markedly to 5.3 ($P \leq 0.001$). The resulting dehydrated herb, brown with sporadic greening reflected a substantial loss of 72.9% of its initial chlorophyll content and a high pheophytin content of 684 mg/10g DM. Increased acid formation and increased susceptibility of chlorophyll to acid action favouring pheophytin formation is reported to occur during the heat processing of green commodities (Meyer, 1960; Davidek et al., 1990).

Percent essential oil

The shado beni owes its characteristic odour and flavour to the aromatic oil inherent within its tissues. Yeh (1974) reported an essential oil content of the fresh shado beni of 0.05–0.10% containing 72.7% of a mixture of 2,4,5-trimethylbenzaldehyde, 5-dodecanone and 4-hydroxy -3,5-dimethylacetophenone.

The oil content of the fresh herb declined significantly ($P \leq 0.05$) from an initial value of 0.276% d.b during drying. As the drying air temperature was increased from 35 to 65 °C, the % oil of the dried herb decreased from 0.095% d.b to 0.030% d.b (Table 1) Statistical analysis revealed a significant decline ($P \leq 0.05$) from an oil content of 0.095% d.b for the herb dried at 35 °C to 0.030% d.b for the herb dried at 45 °C. No significant difference in the reduced oil contents was found between shado beni dried at the highest air drying temperatures of 55 and 65 °C, i.e. 0.049% and 0.030% d.b respectively. Shado beni dried at 35 °C, while showing a reduced oil content retained its characteristic odour as indicated by the pungency of the oil extracted. At the higher drying temperatures of 55 and 65 °C, there was deterioration of the herb quality, as off-odours were detected from the extracted oil. Similarly, drying of sage and thyme at a high temperature of 80 °C was found unsuitable while at 50 °C aroma loss was reduced (Koller, 1988).

Table 1 Chemical properties of fresh and dried shado beni dried at 35–65 °C under natural convection

Product and treatment	[a]Chlorophyll (mg/100 g DM)	[a]Pheophytin (mg/100 g DM)	[a]pH	[a]Percent essential oil (d.b)	Peroxidase test
Fresh	1,209	0	5.9	0.276	positive
Dried (°C)					
35	1,029	460	5.8	0.095	positive
45	740	488	5.7	0.030	positive
55	435	609	5.4	0.049	positive
65	326	684	5.3	0.030	positive
[b]SEM	88.43	55.82	0.04	0.010	

[a] denotes the mean of two values

[b] denotes the standard error mean value

Effect of pre-drying treatments on the quality of dried shado beni

Colour, pigment, pH changes and essential oil

Consistent with previously reported results, changes in colour from green, typical of freshly harvested shado beni, reflected by chlorophyll and pheophytin concentrations were directly related to changes in pH during dehydration. Untreated (control) dehydrated shado beni declined significantly in pH ($P \leq 0.001$) from an initial value of 5.9 to 5.4. This was accompanied by a significant decline ($P \leq 0.01$) in its chlorophyll content from 1,202 mg/100 g DM for the freshly harvested herb to 435 mg/100 g DM. These changes paralleled extensive pheophytin formation averaging 609 mg/100 g DM resulting in an olive-brown discolouration of the dehydrated herb (Table 2).

Compared to the untreated (control), blanching in steam did not markedly influence the appearance of the dehydrated herb as differences in pH, chlorophyll and pheophytin concentrations were neglible (Table 2). Blanching in water and magnesium carbonate however, effectively reduced loss of the green colour during dehydration. Water-blanched dehydrated shado beni, with a pH of 6.1 and a chlorophyll content of 1,178 mg/100 g DM was attractively bright green in colour and showed no signs of browning. This 'brightening effect', also observed by other researchers, is a result of the removal of air from the vegetable surface and intercellular spaces (Mackinney and Weast, 1940; Meyer, 1960; Woolfe, 1979). The magnesium carbonate-blanched, dehydrated herb, which increased in pH ($P \leq 0.001$) by 0.9 units (pH of 6.8), was dark green in colour (chlorophyll loss of only 15.2%) and showed no signs of browning. Sweeney and Martin (1961) working on spinach, reported a 90% retention of chlorophyll at a pH of 6.8. Alkali salts are claimed to prevent or minimize pheophytin formation by neutralizing plant acids released or formed during heat processing (Lioutas, 1989; Davidek et al., 1990).

Table 2 Chemical properties of fresh and dried shado beni subjected to various pre-drying treatments prior to drying under natural convection at 55 °C

Product and treatment	[a]Chlorophyll (mg/100 g DM)	[a]Pheophytin (mg/100 g DM)	[a]pH	[a]Percent essential oil (d.b)	Peroxidase test
Fresh	1,202	0	5.9	0.460	positive
Dried					
Steam blanched	587	534	5.5	0.100	negative
Water blanched	1,178	0	6.1	0.056	negative
$MgCO_3$ blanched	1,019	0	6.8	0.093	negative
Control	435	609	5.4	0.107	positive
[b]SEM	79.4	65.3	0.04	0.05	

[a] denotes the mean of two values

[b] denotes the standard error mean value

For all treatments investigated, the oil contstituent of the shado beni, declined significantly during dehydration ($P \leq 0.001$) from an initial value of 0.460% d.b (0.050% wet basis) for the freshly harvested herb (Table 2). Statistical analysis revealed no significant difference in oil yield between pre-drying treatments (% range from 0.056 to 0.107% d.b), all products of dehydration retaining a faint odour typical of the pungently scented, fresh herb.

CONCLUSIONS

Blanching of shado beni in water or magnesium carbonate prior to dehydration markedly minimized loss of the green colour, typical of the freshly harvested herb. Irrespective of pre-drying treatments, however, drying at a high temperature of 55 °C increased the loss of the volatile oil constituent of the herb. While the drying time for the untreated/unblanched herb at 35 °C was lengthy (80 h as opposed to only 9 h for alkali/water-blanched herbs dried at 55 °C), for herbs dried at the lowest temperature of 35 °C essential oil retention was greatest.

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