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Preliminary communications

MICROWAVE FINISH DRYING TO IMPROVE PHYSICAL AND CHEMICAL PROPERTIES OF APRICOTS

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This study investigated physical and chemical properties of microwave finish dried apricots. Microwave treatment caused significant ($P<0.05$) decrease in SO_2 content of apricots at power levels over 400 W. As the power level increased moisture content decreased. No significant ($P>0.05$) alteration in *L* value was observed. Redness property (*a* value) increased significantly ($P<0.05$) with the increase in microwave power intensity. The taste and overall acceptance scores of the microwave finish dried apricots were smaller ($P<0.05$) when high (over 400 W) level of microwave power was used. Microwave finish drying method reduced the time of drying.

Keywords: apricot, microwave, drying, colour, sensory properties

Microwave has been used for various purposes including pasteurisation, sterilization, cooking, reheating, enzyme inactivation, drying, blanching, baking and defrosting of frozen products (CURNETTE, 1980). Microwave drying takes advantage of the polarization occurring at molecular and atomic levels. The heat developed in a material by alternating electromagnetic field results from the polarization process within the product when the molecules in the material revolve and move laterally millions of times per second trying to line up with the changing electric field (VEGA-MERCADO et al., 2001). Typical examples of microwave application are carrot, pea, onion, cereal products, pasta and mushroom drying (GIESE, 1992). In drying of fruits and vegetables various pre-treatment such as blanching of apples, dipping in alkali of grape and prunes, sulphiting of apple, apricot, peaches are used to inhibit enzymatic and non enzymatic browning (RATTI & MUJUMDAR, 1996).

Microwave drying was reported to be advantageous over traditional drying methods in terms of product quality and cost (ROSENBERG & BOGL, 1987a). Air dehydration of fruits may result in reduction in some quality properties such as poor rehydration, textural shrinkage, etc. (MASKAN, 2000). Drying of apples by microwave has been found to result in a reduction in microbial count and surface oxidation (ROSENBERG & BOGL, 1987b). The use of microwave and conventional drying methods has been compared for onion and carrot drying. Two-stage drying including hot air

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drying followed by a microwave finish drying has been used to enhance product quality characteristic (PRABHANJAN et al., 1995; FENG & TANG, 1998) such as limited colour degradation caused by enzymatic reactions (KROKIDA & MAROULIS, 1999).

Turkey produces about half of the world's total dried apricots. Apricots are traditionally sun-dried after pre-treatment with SO_2 obtained by burning sulphur in specially constructed rooms, to a moisture content of 23 to 28 g/100 g (wet basis). Sun drying permits production of a product with a rich orange colour, translucent appearance and desirable gummy texture; however, the slowness of the process, exposure to environmental contamination, dependence on the weather and the hand labour requirement are some of its disadvantages (MAHMUTOGLU et al., 1996). The objective of this study was, therefore, to investigate the effect of microwave finish drying on some quality parameters of apricots as an alternative to traditional sun or hot air drying.

1. Materials and methods

1.1. Material

Kabaası apricots (a local variety with a moisture content of about 80 g/100 g) were harvested from the Malatya region of Turkey in July 2001. The fruits were sorted (medium size, 140–160 apricots/kg), sulphited and sun dried before pitting to a moisture content of about 50 g/100 g and sun drying continued until a moisture content of about 24 g/100 g (wet basis) was reached.

1.2. Microwave finish drying

Sun dried apricots were washed to remove dirt, extraneous material. The moisture content after washing was about 24% (wet basis). A domestic microwave oven (Arcelik MD 500, Turkey), with maximum output of 800 W at 2450 MHz was used. Apricots were placed in a glass Petri dish and microwave was applied at a power intensity of 400, 550, 700 and 800 W for 2 min. Control apricot samples dried by hot air at 60 °C for 180 min with air velocity of 3 m s^{-1} using a cabinet (5×3×4 m) drier in a commercial apricot processing plant (Sutcuoglu Kayısı Isletmesi, Turkey).

1.3. Methods

The samples were homogenized in a Waring blender and apricot puree was obtained. Moisture content and SO_2 concentration were determined by A.O.A.C. (1975) methods. Colour was determined using a Minolta CR-200 chromameter (Minolta Co., Ltd., Osaka, Japan). An average of eight measurements for *L* (a measure of lightness), *a* (a measure of redness) and *b* (a measure of yellowness) values were recorded.

1.4. Sensory analysis

The method of DECAREAU (1985) was used with some modifications. An eight-member sensory panel was selected on the basis of sensory familiarity with dried apricot at a local apricot processing plant (Sutcuoglu Kayısı Isletmesi). Taste (sweet: 25, sweet-sour: 15, sour: 5, bitter: 0), odour (typical apricot odour: 25, sulphite odour: 15, burnt and other odours: 0), colour (yellow: 25, yellow-orange: 20, orange-red: 15, red-brown: 10, brown: 0), appearance (round-oval: 25, shrink: 10, burnt: 0) and overall acceptance (sum of the scores from taste, odour, colour and appearance) attributes were evaluated. Microwave treated and control apricot samples were coded with 3-digit numbers and served in plastic plates.

1.5. Statistical analysis

Data were analysed by the analysis of variance (ANOVA) and mean comparisons were carried out by least significance test (LSD) at $P<0.05$ using SPSS software version 10. All determinations were made in triplicate.

2. Results and discussion

2.1. Physicochemical properties

Microwave treatment at a power level of 400 W was identical to control whereas higher power applications significantly ($P<0.05$) decreased SO_2 content of apricots (Table 1). The changes in moisture content caused by the application of different level of power intensity were significant. As the power level increased moisture content decreased. The decrease in SO_2 content as the power intensity increased may result from removal of SO_2 by the heat leading to small decrease in lightness (L) value. The loss in SO_2 content is related to the initial SO_2 concentration, drying temperature and duration (PALA et al., 1996) or oxidation and irreversible combination of SO_2 with constituents of the dried fruit (DAVIS et al., 1973).

Table 1. Physicochemical properties of microwave finish dried apricots

Power (W) level	SO_2 (ppm)	Moisture (%)	*L*	*a*	*b*
Control	2598^{a}	23.7^{a}	47.0^{a}	1.70^{d}	25.9^{b}
400	2529^{a}	23.0^{ab}	46.3^{a}	2.45^{c}	27.3^{a}
550	2427^{b}	22.0^{bc}	45.2^{a}	2.95^{b}	26.3^{b}
700	2266^{c}	21.3^{c}	44.6^{a}	3.83^{a}	25.3^{b}
800	2050^{d}	19.7^{d}	44.3^{a}	3.85^{a}	22.5^{c}

Values are the means of the triplicate measurements.
$^{a–d}$: Means with different letter in the same column are significantly ($P<0.05$) different.
L, a, b: Hunter colour values

Power intensity seems to contribute to the darkening of apricots as evidenced by significant increase in *a* values.

Table 1 shows that no significant (P>0.05) alteration in *L* value was observed. The *L* values changed from 44.3 to 47.0 and *b* values from 22.5 to 27.3. PALA and co-workers (1996) reported similar observation for solar and sun dried apricots. It has been reported that internationally reasonable Hunter *L* value is over 40 and *b* is over 20. Redness property (*a* value) increased significantly (P<0.05) with the increase in microwave power intensity. A significantly lower *b* value was obtained for microwave finish dried apricot at a power level of 800 W. The researchers have reported contradictory results. The *Lab* values of microwave dried banana samples have been reported to be not dependent of the microwave power intensity (MASKAN, 2000) but no such dependence was observed by FUNEBO & OHLSSON (1998). The decrease in *Lab* values indicating darkening of colour and occurrence of browning reactions has been attributed to the initial SO_2 concentration, pH, maturity of the fruit, drying method and environmental factors such as temperature and relative humidity (MAHMUTOGLU et al., 1996). Drying may also lead to discolouration caused by non-enzymatic browning (FENG & TANG, 1998).

2.2. Sensory analysis

The effect of microwave power intensity on sensory properties of dried apricots is shown in Table 2. The taste scores of the apricots dried using high (over 400 W) level of microwave power were smaller (P<0.05). Microwave finish drying at a power level of 400 W caused no significant (P>0.05) changes in taste score compared to control. A reduction was obtained in colour and odour scores of dried apricots as the microwave power intensity increased to 550W and 700W, respectively. Microwave power level had no effect on the appearance value of apricot samples. Overall acceptance values of microwave finish dried apricots at microwave power intensity over 400 W were significantly (P<0.05) lower than those of control. Aspects of colour and appearance have been recognized to influence consumer perception of a product (CLYDESDALE, 1993; HUTCHINGS, 1994). ROLLS and co-workers (1982) state that the manipulation of colour in some products can also be used to improve the acceptability when the appearance of the food product is important.

Table 2. Sensory properties of microwave finish dried apricots

Power (W) level	Taste	Odour	Colour	Appearance	Overall acceptability
Control	25[a]	25[a]	25[a]	25	100[a]
400	25[a]	25[a]	25[a]	25	100[a]
550	15[b]	25[a]	20[b]	25	85[b]
700	15[b]	15[b]	20[b]	25	75[c]
800	15[b]	15[b]	20[b]	25	75[c]

Values are the means of the triplicate measurements.
[a–d]: Means with different letter in the same column are significantly (P<0.05) different

3. Conclusion

Reasonable physicochemical and sensory properties and reduction of the time for drying obtained by the application of microwave finish drying using a power intensity around 400 W suggest that this type of drying could be employed as an option to conventional drying methods. The knowledge on physical and chemical properties affecting quality of apricots may be useful in selection of suitable processing parameters in the design of continuous industrial applications for microwave finish drying of apricots.

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