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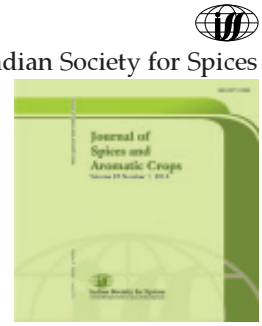

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Pulsed microwave assisted hot air drying of nutmeg mace for better colour retention

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Abstract

A study was conducted on application of novel drying technology for better color retention of mace. Pulsed microwave assisted hot air drying was investigated at three different power levels 0.5 kW, 1 kW and 1.445 kW with 30 seconds pulsation at a hot air temperature of 45°C and the color values of mace were compared with the market and fresh sample using colorimeter. Further, the major flavor compound, myristicin in mace was analysed.

Keywords: color retention, dosage, microwave assisted hot air drying, moisture loss, myristicin

Nutmeg (*Myristica fragrans*) is a fleshy fruit popularly cultivated and processed for two of its spices, namely nutmeg seed and mace (Abdullah *et al.* 2010). Nut of this fruit is called nutmeg and mace is the waxy red colored arillodes of nutmeg seed (Andrzej *et al.* 2012). Dried nutmeg and mace are used as a spice in food industry, in traditional medicines for stomach related diseases and also for extracting oil and oleoresins (Maya *et al.* 2004). Traditionally the nutmeg and mace are dried in shades of sun which usually takes longer time (10-12 days for nutmeg and 5-6 days for mace) for drying and causes color and flavor losses (Haldankar *et al.* 2008). Retention of color and flavor after drying are the major factors that determine the price of mace in the market. It is indeed important to find some alternative method of drying to solve the problem of loss of color in mace during shade drying. In this study, a novel drying technique, pulsed microwave assisted hot air drying is applied for drying of mace, which results in better color retention and myristicin, an important flavour compound of mace.

Fresh nutmeg fruits were procured from a farmer at Peruvannamuzhi, Kozhikode in Kerala and stored at 3^0C. A continuous microwave dryer (Model: PTF2515, Enerzi Microwave systems Pvt., Ltd, Bengaluru) with maximum frequency 2450 MHz and power input ranges from 0 to 1.445 kW was used for the experiment. The dryer has uni, bidirectional conveying belt and also has a hot air blower with an exhaust system. Microwave power level, conveying speed of the belt, hot air temperature can be controlled digitally in this continuous microwave dryer. ColorFlex Hunter colorlab Colorimeter was used to find the color of sample before and after drying treatment. IBM SPSS software version 20.0 was used to analyse the results obtained from the experiments. 10g of mace sample was placed in the bi-directional conveyor belt of Microwave

and power was set at 0.5 kW with hot air temperature at 45°C. The mace sample were exposed to the microwave for 30 seconds along with hot air and then exposed to hot air alone for one minute. Three such cycles were applied to the sample and the weight of the sample was taken after each three cycles and tabulated. This was continued for 45 minutes and moisture content (db %) at each interval was calculated. Pulsed microwave assists in loosening the bound moisture of mace and hot air subsequently absorbs this moisture.

The effect of drying with high power level and less microwave exposure time is important for this study. The input power and time of exposure are highly correlated with each other. Hence the following equation consists of power and exposure time was used to study the drying effect of mace (Joyner *et al.*, 2013).

Dosage KJ = [Microwave power (kW) × Exposure time (s)] / [Initial weight of sample (g)]

The experiment was repeated for higher power levels at 1 kW and 1.445 kW for the same time - temperature - pulsation combination for duration of 45 minutes. After drying, the color values of the dried samples were analysed using ColorFlex Hunter color lab colorimeter for all power levels and compared with color values of commercial sample and fresh sample. Initial moisture content of the mace was estimated using hot air drying at 105^{0}C for 24 hours.

The color values of market sample, fresh sample and microwave treated samples were tabulated in Table 1. The values of color were given in terms of "Lab" scale, where 'L' represents darker to lighter, 'a' represents Green to Red and 'b' represents Blue to Yellow. For Mace, the desired

Table 1. Color value comparison of market, fresh and microwave treated samples to assess the color retention

Parameter	Market sample	Microwave exposure 30s with hot air drying sample at 45^{0}C			Fresh sample before drying
		0.5 kW	1.0 kW	1.445 kW	
L	29.54	22.78	23.65	24.01	32.2
a	14.35	18.15	19.34	18.76	34.11
b	8.65	7.17	8.12	8.78	16.19

Table 2. Performance measures of drying rate and moisture loss based on predictive model at various power levels

Power level (kW)	Predictive model of drying rate against dosage	Drying rate*	Co efficient of determination (R^2)	Average moisture loss
0.500	$y = 111.09\ e^{-0.03t}$, t e > 0	0.03	0.88	30%
1.000	$y = 115.9\ e^{-0.02t}$, t e > 0	0.02	0.95	43%
1.445	$y = 118.87\ e^{-0.01t}$, t e > 0	0.01	0.97	84%

*(Moisture loss/gram/sec); y=moisture content (db %); t=dosage in kJ g^{-1}

Table 3. Myristicin content retention in raw, market and microwave assisted hot air treated mace sample at 1kW power level using GC-MS

Sample	Retention time (min)	Peak area of myristicin %
Raw	7.55	21.06
Market	7.65	17.23
Microwave	7.58	16.00

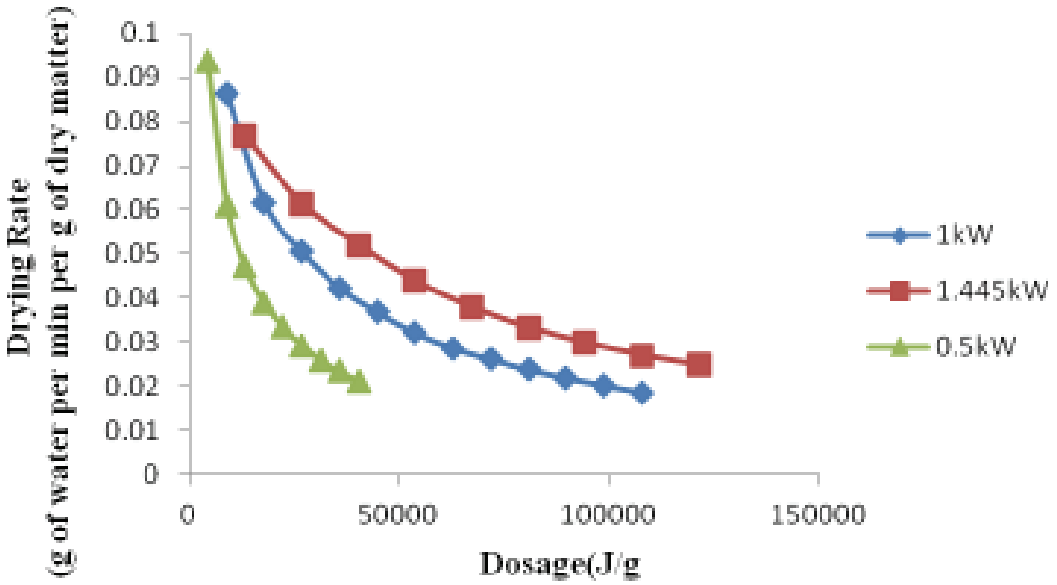

Fig. 1. Microwave assisted hot air drying rate against dosage at the power levels of 1.0, 1.445 and 0.5 kW

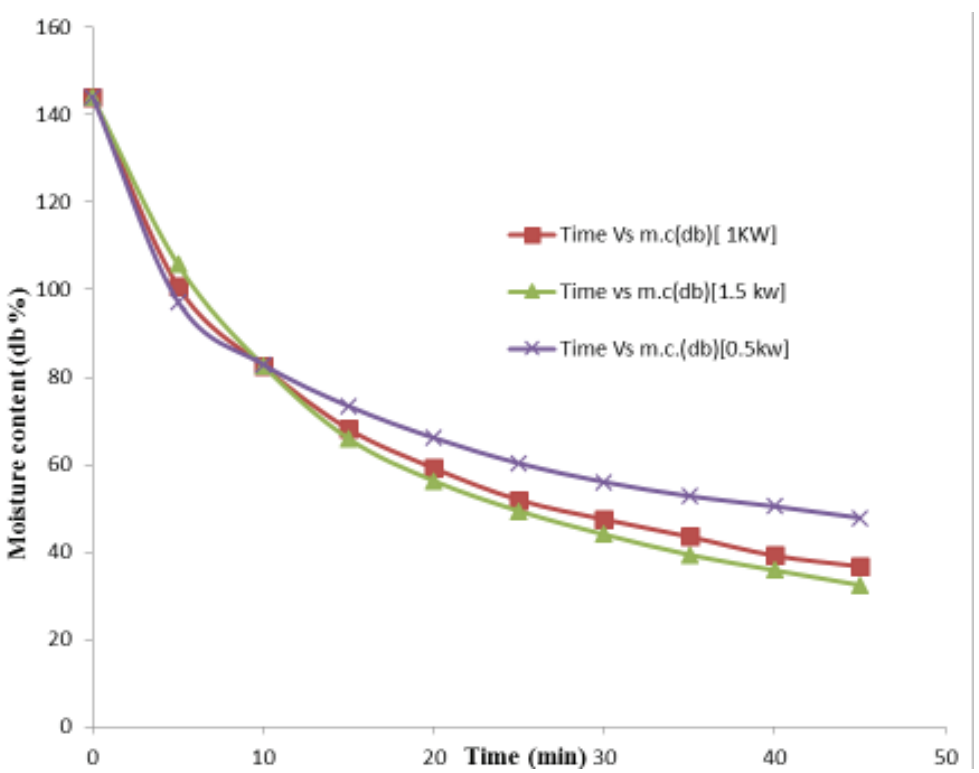

Fig. 2. Effect of microwave assisted hot air drying on moisture content (db%) against drying time at different microwave power levels

color usually darker than lighter, more Reddish and less Yellowish. From Table1 it is visualized that compared to fresh sample, market sample were lighter and yellowish and the microwave treated samples were more reddish and less yellowish than market sample. Among the Microwave treated samples, power level of 1.445 kW was darker, 1 kW was more reddish and 0.5 kW was less yellowish. It is clear that microwave assisted hot air treatment has more color retention when compared to market sample.

Using SPSS 20.0 the experiment data were analysed and co-efficient of determination (R^2) was used to evaluate predictive model of the dosage against drying rate. Fig. 1 represents the microwave assisted hot air drying rate and dosage. Table 2 gives the performance measures of the experiment.

Fig. 2 shows that moisture content of mace decreases with increase in drying time. The comparison between the different power levels gives an idea that at higher power levels the moisture evaporation from mace is high. On the average, microwave power level 0.5 kW, the moisture loss was 30% whereas at 1 kW it was 43% and at 1.445 the moisture loss was 83%.

Table 3 shows the myristicin content in raw mace, market sample and micro wave (1kW) assisted hot air dried sample found using GC-MS (Model: GC Clarus 500 Perkin Elmer). It reveals that the myristicin content was retained to a considerable extend on the microwave assisted hot air dried mace with almost same retention time. This study shows that microwave assisted hot air drying is an alternative novel drying technique for drying nutmeg mace, as it retains color and myristicin flavour. However further studies are required to evaluate this novel drying technique with different microwave exposure time, temperature and dosage combination.

References

Abdullah M H R O, Ch'ng P E & Lim T H 2010 Determination of some physical properties of nutmeg (*Myristica fragrans*) seeds research. J. Applied Sci. Engg. Tech. l 2: 669–672.

Andrzej L, Dawidowicz & Michal P D 2012 Determination of myristicin in commonly spices applying SPE/GC. Food Chem. Toxicol. 50: 2362–2363.

Haldankar P M, Khandekar R G, Rangwala A D & Joshi G D 2008 Nutmeg. In: Tree Spices, Vol. 2 (pp.203–246), Parthasarathy V A, Parthasarathy U & Kumar A (Eds.). Tomorrow and Today Printers and Publishers, New Delhi.

Joyner J & Yadav B K 2013 Microwave assisted dehulling of black gram (*Vigna mungo* L). J. Food Sci. Technol. 52: 2003–2012.

Maya K M, Zachariah T J & Krishnamoorthy B 2004 Chemical composition of essential oil of nutmeg (*Myristica fragrans* Houtt.) accessions. J. Spices Arom. Crops 13: 135–139.