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IMPACT OF VARIOUS DRYING TECHNIQUES TO REDUCE OIL ABSORPTION IN BLACK GRAM PAPAD

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Abstract: Drying is a one of the preservation technique which improves the keeping quality of the products. The present study is about microwave assisted drying of papad enriched with soy lecithin. The results are compared with other drying methods and control sample. Soybean by-product (Soy lecithin) as a pre-treatment is used in the ratio of 1.5 gto reduce oil absorption since it helps to retain nutrients, colour, flavour better. Physico-chemical parameters like oil uptake ratio, expansion, crispiness, hardness, colour of fried papad were determined. Oil content and oil uptake ratio was found to be less in microwave drying as compared to control sample, i.e., between 40- 45 % reduction. Microwave assisted drying of papad has shown high organoleptic acceptability, but considering the cost economics, it is less for sun drying compared to microwave drying and tray drying methods.
Keywords: Papad, *Vigna mungo*, Sun dying, Tray drying, Microwave drying, Oil content and oil uptake ratio.

1.1 Introduction

Papad is a snack having crunchy wafer-like taste and is mainly made out of black gram flour (*Phaseolus mungo)*, rice, green gram, sorghum. Other ingredients, such as common salt, carbonates, spices and oil are also added. Papads are made out of dough by rolling out into circular shape of 0.3-2.0mm thick with moisture level of 14-15% (*R.G. Math. et al., 2003*). It is extensively consumed in South India and many parts of Southern Asia and is also known as Papadam. Papad made from black gram (94.4 %), rice (63.8 %) and green gram (33.3 %) was mostly preferred by the consumer acceptance (Kamat, Yenagi, & Nagannur, 2009). Chemically it was a mixture containing 1.6–58.3% carbonates, 0–18.9% bicarbonates, 1.2–72.0% chlorides and 0–2.6% sulphates giving desirable dough character, crispness and expansion (Venkatesh *et al.*, 1970); salt was added for the taste and spices was for flavourings; and oil for mixing of all ingredient and dough processing.

The nutritional benefits of papad are high as, black gram is its core ingredient and there are numerous health benefits associated with black gram. Black gram complements the essential

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amino acids provided in most cereals and plays an important role in the diets of the people of India and Nepal. Black gram has been shown to be useful in mitigating elevated cholesterol levels, helps to maintain digestive system and is good for hair growth. It is good for mild diabetes, it helps to purify the system and remove toxins from the body. It is a rich source of protein (20-22%) (Shurpalekar, 1986), minerals and polysaturated fatty acids. Pepper is well known in Indian cuisine and asafoetida works as a flavour enhancer (Ramachandran, 2016).

Lecithin is known to be a multi-functional surface-active agent. It is lipotrophic as well as it is hydrotrophic. Because of this dual nature, lecithin molecules tend to position themselves at the boundary between immiscible materials, such as oil and water. Soy lecithin has also proved have various functions like Emulsifying, Solubilisation, Suspension, Wetting/ Instantizing, Lubrication and Release Crystallization Control as per Szuhaj (1980). Lecithin is largely used in our daily foods because of its enormous properties. It is used in margarine for its anti-spatter property, it is widely used in chocolates, caramels for coating purpose. It helps to control weep age, and sticking, also it gives softening, plasticizing, and release effects. It is used in baked goods, cheeses, meat and poultry products, dairy and imitation dairy products, and still other products (Stanley, 1950; Brekke, 1980; Szuhaj, 1980, 1983).

Traditionally, the drying of papad there was mostly sun drying method preferred and it is still practised in India, but still there are many disadvantages associated with it. In this drying method moisture from the interior papad was diffused to the papad surface to replenish the evaporated surface moisture (Mahesh Kumar, 2011). Tray dryer is another technique adopted by industrial use to reduce drying time of papad, but in tray drying there is uneven drying occur due to poor airflow distribution in the drying chamber. Implementing the proper design of a tray dryer system may eliminate or reduce non-uniformity of drying and increases dryer efficiency.

Microwave drying is other technique which has been proved to be another best method of dehydrating high humid products without affecting its flavor, texture and other sensory attributes. It is based on unique volumetric heating mode facilitated by electromagnetic radiation at 915 or 2,450 MHz (Feng*et al.,* 2012).

1.2 Objective

To reduce oil absorption from black gram papad by using microwave assisted drying along with different drying methods (Sun drying and Tray drying) to improve the nutritional quality of black gram papad.

2. Material and Methods

2.1 Materials

(a) Black gram powder of Krishna brand was purchased from the local market of Thanjavur, Tamil Nadu, India.

(b) Soy lecithin was procured from the Sakthi Sugars LTD. Soya Division, Code-SL/20150724, from Coimbatore, Tamil Nadu

(c) Asafoetida powder (Hing) and Black pepper powder of the brand of Aachi was used.

(d) Common salt of the bran 'Tata Salt' was used.

(e) Palm oil of the brand of 'Ruchi Gold' was used.

2.2 Method

Preparation of the papad: The papad was prepared from soft dough obtain by mixing 0.5 g asafoetida powder, black pepper powder 1.5g and 5 g salt and then adding 40 ml of water with dissolved soy lecithin1.5 g to the 100 g of black gram flour (Table no. 1). The dough was kneaded until it turned soft and kept for half an hour for resting. Then dough was divided into small balls having 5-6 g weight. The small ball then pressed in the mechanically operated papad making machine with having circular disc of the both upward and downward side and get 0.3-0.5 mm thickness and diameter having 15 cm. Then the papad was dried with open sun drying method for daytime to a moisture level upto 14 % after that it was packed into the polyethylene bags (Sunita *et al.*, 2000).

The papads were fried by deep fat frying technique at 180^0C for 15-20 sec. After that, fried papad with distinct aroma having yellow to light brown colour were obtained. The sample was packed for the further physico-chemical analysis. Soft dough was prepared by the above and change the drying technique. In tray drying, papad was kept at 40^0C to a moisture level 14 % and in microwave drying the temperature was kept same as that of tray dryer i.e. 40^0C to a moisture level 14 %, then packed in polyethylene bags.

Table 1: Recipe of papad making and Ingredient list

Sr. no.	Ingredients	Weight
1	Black gram flour	100 g
2	Asafoetida	0.5 g
3	Black pepper	1.5 g
4	Salt	5 g
5	Soy lecithin	1.5 g
6	Water	40 ml

2.3 Analysis of papad

(a) Moisture content of dried papad and fried papad was done for all samples by drying in a hot air oven method at 105^0C until constant weight (AOAC, 1975).

(b) pH of water extract of papad was carried out. The sample was crushed and soaked for 1hour and then the pH was measured in the pH meter (specification for papads: ISI 2639–1972. Indian Standards Institution, New Delhi).

(c) Oil content of fried papad was done by using **soxhlet extraction** with petroleum ether (60^0 to 80^0C fraction) as a solvent (AOAC, 1975).

(d) Oil uptake ratio (U_R) was calculated from the moisture content of the dried papad (M_b) and moisture content of the fried papad (M_a) by using formula given by Pinthus *et al.*, (1993):

$$\textbf{Oil Uptake Ratio (UR)} = \frac{Oil\ content\ (\%)}{M_b - M_a}$$

(e)Expansion of fried papad was calculated by the using formula of Anna-pure *et al.*, (1997):

$$\%\ \textbf{Expansion} = \frac{Diameter\ of\ papad\ after\ frying - Diameter\ of\ papad\ before\ frying}{Diameter\ of\ papad\ before\ frying} \text{ X } 100$$

(f) Texture of fried papad was done by using stable Microsystems texture analyser using 3-point bending ring probe. The texture was quantified as the total load (g) required to rupture the sample.

(g) Colour of the fried papad was calculated by Hunter Lab units 'L' (lightness/darkness), a*(redness/greenness) and b*(yellowness/blueness). It provides the reading in terms of 'L', a and b where, luminance (L) forms the vertical axis, which indicates whiteness to darkness (Francis & Clydesdale, 1975). Chromatic portion of the solids is defined by: a (+) redness, a (-) greenness, b (+) yellowness and b (-) blueness. Three measurements were performed and the results were averaged. Colour value was calculated by the formula of Francis & Clydesdale, (1975)

$$\Delta\,\mathbf{E} = [(L_0 - L)^2 + (a_0 - a)^2 + (b_0 - b)^2]^{1/2}$$

(h) Sensory analysis of the fried papads was done by panellist using a hedonic scale of 1–10 with 1–2: very poor, 3–4: poor, 5–6: medium, 7–8: good, 9–10: very good.

3 Results and Discussion

3.1 Moisture and pH of the papad

Moisture content in different drying techniques was found significantly different from each other's. The least moisture content was recorded in the papad dried by using microwave drying method (10.26 ± 0.41 %) and the papad dried by using sun drying technique shows the

high moisture content as compared to the tray drying and microwave drying technique (13.33 ± 0.46 %). The pH of water extract, however decreases in microwave drying technique (6.77 ± 0.02 %) and the value of pH got increased in tray drying and sun drying, but there is not too much difference in the pH value shown in (Table no. 2). The soy lecithin added papad shows the lower pH as compared to the control sample because, soy lecithin improves the nutritional quality of papad and in soy lecithin added papad there is no alkalinity present as compared to the control sample.

Table 2: Effect of incorporation of soy lecithin by using different drying methods on Moisture content and pH of the papad

Sr.no.	Parameters	Control Sample	Solar Dried	Tray Dried	Microwave Dried
Before frying (after different drying methods)					
1	Moisture (%)	14.15 ± 0.30	13.33 ±0.46	12.75 ± 0.11	10.26 ± 0.41
2	pH of water extract	8.00 ± 0.55	6.83 ± 0.01	6.80 ± 0.08	6.77 ± 0.02
After frying					
3	Moisture (%)	4.53 ± 0.28	3.06 ± 0.10	2.91 ± 0.16	1.53 ± 0.04

3.2 Oil Content and Oil Uptake

The papad obtained by different drying methods was fried in the deep fat fryer at 180^0C for 15-20 Sec and found the oil content by soxhlet method using petroleum ether solvent, the results show that there was less oil absorbed in the microwave dried papad (9.55 ± 0.80 %) as compared to other drying methods (Table no. 3). The oil content was reduced in all drying method as compare to the market sample, because soy lecithin acts as a surface active agent and it reduces the surface tension of the papad, as surface tension affects the oil uptake. As surface tension increases, there will be increase in oil content and oil uptake in the fried papad. The lower oil uptake was found in the microwave dried papad (1.09 ± 0.12 %) as compared to the other two drying methods given in (Table no. 3)

Table 3: Effect of incorporation of soy lecithin by using different drying methods on Oil Content and Oil uptake ratio of the fried papad

Sr.no.	Parameters	Control Sample	Solar Dried	Tray Dried	Microwave Dried
1	Oil content (%)	19.01 ± 1.01	14.80 ± 1.00	11.99 ± 0.66	9.55 ± 0.80
2	Oil uptake ratio UR (%)	2.01 ± 0.04	1.48 ± 0.11	1.21 ± 0.04	1.09 ± 0.12

3.3 Expansion of fried papad:

The expansion result shows that the soy lecithin containing papad was having less expansion as compared to the control papad. The less expansion was found in soy lecithin added papad due to the less moisture (Table no. 4) as compare to the control sample and the main reason is that, in soy lecithin added papad we didn't add the sodium bi-carbonate or carbonate these both are responsible for the expansion of the papad. We found that the expansion was more when the oil content was more in the papad due to the high moisture. Our main aim of this study was to reduce oil absorption from the fried papad.

Table 4: Effect of incorporation of soy lecithin by using different drying methods on Expansion ratio and Texture of the fried papad

Sr.no.	Parameters	Control Sample	Solar Dried	Tray Dried	Microwave Dried
1	Expansion (%)	5.42 ± 0.71	3.28 ± 0.27	2.38 ± 0.57	1.80 ± 0.05
2	Texture (g)	1343.86 ± 27.02	1269.66 ± 49.17	1055.73 ± 31.70	855.97 ± 30.42

3.4 Texture of fried papad:

The texture is a physical parameter it can play an important role in the papad. As the moisture is more, the hardness is more and crispiness was less. Drying under different drying methods can affect the textural properties of fried papad (as the moisture content was more there will be over frying leads to the hardness of the papad). The papad dried by using microwave drying method was found to be less hardness (855.97 ± 30.42) and more crispiness as compare to the other two drying methods (Table no. 4).

3.5 Colour of fried papad:

Colour is the physical attribute that can easily compare with the naked eye. The ΔE value of papads dried under different drying methods was determined and it was found that the microwave dried papad was having high ΔE value (19.16 ± 1.56 %) as compare to other drying method and control sample from market (Table no. 5).

Table 5: Effect of incorporation of soy lecithin by using different drying methods on Colour (ΔE Value) of the fried papad

Sr.no.	Parameters	Control Sample	Solar Dried	Tray Dried	Microwave Dried
1	L	60.45 ± 2.03	66.56 ±1.02	69.08 ± 0.68	72.16 ± 0.26
2	a	5.13 ± 1.63	2.86 ± 0.59	3.40 ± 0.41	3.64 ± 0.40
3	b	18 ± 2.08	27.06 ± 1.51	30.23 ± 2.03	33.12 ± 1.87
4	ΔE Value		11.16 ± 1.68	15.06 ± 1.83	19.18 ± 1.54

3.6 Sensory Evaluation:

The scores for all the papads *i.e.* control and those containing soy lecithin added papads dried under various drying methods adapted for drying of papad varied in the range of 8-9, indicating no alteration in their sensory profile. Since the scores were more or less identical, results are not tabulated.

3.7 Conclusion

Addition of soy lecithin in all drying methods, the papad which were dried by using microwave drying methods shows the lower oil content as compared to other drying methods and control sample. Also microwave dried papad shows that it was having lower oil uptake, lower pH, lower hardness and high in ΔE value as compared to other samples. The control sample shows higher expansion followed by sun dried papad shows higher expansion value.

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