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Effect of Roasting on Stability of Curry Powders

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***Abstract*: In this research, dry spices of good quality are chosen and are ground to process curry powders namely Sabji masala. All the experimental samples were unit packed in 12 Micron PET/12 Micron MET PET/35 Micron Polyethylene pouches and held separately at 27° C ± 2° C, 65% RH and 37° C ± 2° C, 75% RH for 9 months (Ambient) and 3 months (Accelerated). Samples were processed in both roasted and unroasted forms to conclude the best fit in terms of shelf life. Upon storage at different conditions, it is found that unroasted forms are less stable considering Moisture, Volatile oil, Water Activity and colour compared to roasted forms. All the samples are measured sensorially by 9-point hedonic scale and each product exhibited different shelf life at different temperatures and humidities. These products were judged as acceptable or unacceptable based on sensory scores on hedonic scale. Evaluated curry powders are useful in the preparation of varieties of dishes.**

***Keywords*: Curry powders, Moisture, Volatile oil, Accelerated, Ambient, Shelf life.**

1. Introduction

Curry powder is a subtle blend of spices, specially combined to enhance the taste of both vegetarian and non-vegetarian dishes. These are dry blends of different spices, herbs and turmeric, that are used as the base of curries. These are balanced with acids, salt, sugar and oil and can be used to develop emulsions & topical seasonings. These powders have originated in south India and travelled throughout the world (Indiramma, 2008). Due to increasing ethnic diversity, the demand for the creation of the new line of curry powders has been increased. As a result, formulation of different curry powders like Sabji, Spice mixes, Hot curry powders, Mild curry powders, Malaysian curry powders etc., has been initiated.

Curry powders are formulated with different types of ingredients. These ingredients add health benefits besides providing taste and aroma to the cuisines. These are also known to provide certain antioxidants, which have chemoprotective properties. Each ingredient contains an active principle, which gives adorable benefits when consumed. These are extensively known for their aroma due to the presence of volatile flavour compounds. These compounds are available in plenty after fresh processing (Ramya Addala, 2015). About 48 aroma yielding compounds were identified in curry powders. Forty eight compounds mainly comprising 36 terpenes, 5 alcohols, 4 benzenes, 2 carbonyl compounds, and 1 ester, were identified from the curry powders. The main volatile compounds were cumin aldehyde, anethole, and eugenol. Composition of volatile oil changes with formulation (Tran Van Cuong et al., (2014)).

Spices and spice products are generally stated under "shelf stable foods" as their moisture content and water activity are low compared to other food matrices. These are those which do not require any special condition suitable for the growth of microbes. These are those which are very dry, highly acidic and with high salt content. This type of food shows flavour and appearance deteriorations, but may take a long time (Susan Duncan (2017)).

The two main important aspects of curry powder are formulation and shelf life. After formulation, the product must be tested regarding shelf-life aspects which directly affects the longer market presence of the product. Shelf life is the period of time over which curry powder maintains safety and quality under reasonable, foreseeable conditions of distribution, storage and use. The objective of the present study is to compare the stability of roasted and unroasted curry powders and to conduct shelf-life studies.

2. Review of Literature

Seema Nayak et al., (2017) studied curcumin and reported 69% of carbohydrates and 13% of moisture presence in dried rhizomes. Rodrigues et al., (2011) stated that edible oils of plant origin may affect the structure, stability, taste, aroma, storage quality and sensory and visual characteristics of the foods. El Badrawy et al., (2008) reported that microwave roasted peanuts are better than ordinary roasted peanuts in terms of chemical composition and mineral contents. Tran Van Cuong et al., (2014) stated that aroma formation in roasting is a complex process, including Maillard and Strecker's reactions and thermal degradation. Slavica Milorad Blagojevich et al., (2016) studied metal concentrations in spices and reported the Maximum concentrations of lead (0.79 ppm), Mercury (0.11 ppm) and arsenic (0.51 ppm) in the samples of ginger, green peppercorns and black peppercorns, respectively.

European Spice Association (2011) has concluded that all the spice products must not contain more than 0.65 water activity. The United States Department of Agriculture (2016) reported the approximate composition of curry powders. It has stated that the product on average contains 8.8g of moisture, 14.29g of Protein, 14.01g of Fat, 55.83g of carbohydrates.

G.E Ibhrahim (2012) studied flavour and defined it as the

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experience of the combined perception of compounds responsible for taste and aroma. Susan Duncan (2017) studied the importance of processing in spices regarding sensory changes and stated that processes effective for killing pathogens in herbs and spices affect sensory characteristics, often to the degree of differentiating spice quality from that of untreated spices.Jannat et al., (2010) stated that optimum temperature and time of roasting of sesame seeds to obtain the most antioxidants and total phenolic content was 200º C for 20 min.Vinod Uttam Rao (2011) studied the effects of roasting and boiling on ginger and turmeric and concluded that roasting increases the extraction efficiency of antioxidants.

Ramya Addala et al., (2015) reported the optimum storage conditions for chilli powder for color retention as 16º C and should maintain 10-11% moistures. Sreekumar D Menon (2015) stated that blended spices are the resilient mix of spices composed of different ingredients. Due to the presence of more than one ingredient, final stability of the product may alter. and stated that dry forms are more stable than wet forms.Visith Chavasit et al., (2011) studied shelf stability, sensory qualities and bioavailability of Iron fortified curry powder of Nepal origin and recommended that commercial iron-fortified curry powders should be packaged in metalized plastic bags inside paper boxes.Reema et al., (2006) reported that curry powders are known to provide antioxidants with chemoprotective properties.

3. Materials and Methods

The present study was conducted in the Food Technology laboratory, Pydah college and the samples were sent to third party labs for critical analysis. The study is aimed to study the effect of roasting on the stability of curry powders. Both roasted and unroasted curry powders are processed at pilot scale in order to conclude which form is stable i.e., either roasted or unroasted form. The samples were analysed sensorially and chemically. The process adopted to carry out the present study is given below.

Procurement of Raw materials: Spices used for the formulation are procured in bulk from the land of spices "Kerala". Binders are procured from local markets. Dehydrated ingredients are collected from Gujarat. Top food grade materials are chosen and are graded internally. Experimental objects in the section of curry powders include sabji masala.

A. Critical Parameters for Curry Powders

Moisture: Not More than 14% by weight, Volatile oil: Not More than 0.25% (V/W) on dry basis, Non-Volatile Ether Extract: Not less than 7.5% by weight on dry basis, Edible common salt: Not More than 5% by weight on dry basis, Ash insoluble in dil HCl: Not more than 2% by weight on dry basis, Crude Fibre: Not more than 15% weight on dry basis, Lead: Not more than 10 ppm on dry basis.

B. Methodology

The samples were processed by using pilot scale hammer mill and sieve. Ingredients for processing of curry powders were roasted in an induction-based heat source at 80 ºC for 10 minutes. Based on the experiment outline, 3 kg of each product is prepared by using pilot scale hammer mill and sifter. After processing, the samples were packed as 250g each, in proposed packing material and sealed. Unroasted samples are also processed excluding roasting. All the samples were lodged into the stability chamber at a time for the purpose of stability testing, to avoid uncertainties.

C. Stability Study

All the samples are packed in the packaging material made of 12 micron PET/12 micron MET PET/35 Micron Polyethylene. The stock keeping units are set as 250g. For ambient study samples are placed in room temperatures and for accelerated study samples are stored in accelerated chambers.

D. Chemical Analysis

1) Moisture

Moisture content is the measure of total water in the matrix. It is a quality factor in determining the stability of spices. At higher levels, it stimulates biological activities, texture changes, accelerates lipid oxidation, enzymatic activities and causes non-enzymatic browning. But upon storage, moisture pickup may occur in curry powders as they are in powdered form. It may even lead to caking and discoloration. Hence controlling moisture in spice related products is essential to preserve quality and stability of the final product.

2) Water Activity

The water activity level that limits the growth of the vast majority of pathogenic bacteria is 0.90. The limit for spoilage molds is 0.70. The lower limit for all microorganisms is 0.60. Controlling water activity to levels below 0.70 will assure that mold will not spoil shipment of spices and spice products. By monitoring these changes in water activity of the blends and fried products, the start point of microbial deterioration can be assessed. For this reason water activity is measured by using Hygrolab water activity analyzer.

3) Volatile Oil

Volatile oil plays a key role in determining the keeping quality of the spices and spice products especially aroma. The amount of volatile oil is determined by distilling the 20 materials with distilled water that is not miscible with oil and then the distillate is collected in a graduate clevenger tube.

4) Colour

L*a*b*values are measured by using Hunter Lab – Colour Flex. The measurement is based on colour opponents' theory. The total change in colour in all samples were determined where L* indicates brightness, a* indicates chromaticity in the green (-) and red (+) axis, and b* indicates chromaticity in the blue (-) and yellow (+) axis

Sensory Evaluation:

The sensory evaluation was performed by an expert in-house panel consisting of four experts of Product Development Lab. In order to create a complete list of all relevant attributes, the panel was presented with several samples of blended spices, ranging from zero day to the final day of the test with chosen intervals. The panel compiled a list through consensus after tasting and smelling the samples, and the list was refined. Nine Point Hedonic scale is used with following purposeful degrees

of liking.

Storage Conditions:

See table 1, 2 & 3.

Shelf-Life Testing:

Blended spices are one of the varietal products among the spice products. Generally, these are formulated with different dry spices as well as fresh ingredients or roasted forms exhibiting different chemical properties. Due to this varied formulations and heat treatments given, it may reduce its characteristic flavour and other sensorial properties up on storage or vice versa. Hence an experiment was conducted to assess the change in stability and also to find maximum possible storage of blended spices in 12 Micron PET/ 12 Micron MET PET /35 Micron Polyethylene pouches both in roasted and unroasted forms.

Shelf-life testing is an important part of the quality maintenance in the spices industry, and also for spice product producers. The concept represents the time period for which top quality can be guaranteed. Most food products do however, remain fresh for several days after their shelf-life date, if the product is stored and distributed correctly, such as low moisture foods. Some more sensitive products that are prone to bacterial spoilage are marked with an expiry date which indicates that the product should not be consumed after the set date i.e; high moisture products.

The experimental object comes under low moisture foods. Performing tests to determine the shelf life of food prone to microbiological spoilage is easily done by different microbiological essays. But other quality aspects are more important when dealing with shelf-life estimations of products where microbiological spoilage is not the main deterioration pathway that occurs, as in blended spices. Chemical changes, enzymatic deterioration and flavour migration in blended spices is best analysed by sensory evaluation. In order to obtain valid results from a shelf-life study, several strategic choices have to be made. The storage conditions practiced for the study, in general, mimic the conditions met by the blended spices during storage and distribution.

Also, a sensory evaluation study relies on the proper reference or control products which should remain unchanged throughout the sensory evaluation. It is also important that the small difference that naturally occurs between product batches does not interfere with the reference products. To avoid any discrepancies, Ideally the reference samples are collected from the same batch as the test products, and stored in such a way that the reference samples remain unchanged. All the control samples are refrigerated, a so-called reversed test design, so that all samples including the references are tested on the same day.

The same procedure is followed throughout the sensory testing. The cut-off point for blended spices was based on sensory panel rejection. If no such data is available the labelling might serve as a basis for a cut-off point. As there are no legal constraints for the formation of off-flavours or colour loss in blended spices, the producer is left to arbitrarily choose the value and hence chosen. In relevance with discussion highlights with product development experts, certain quality parameters are short listed, which are known to affect the product final quality up on storage.

The following were the short-listed parameters and the parameters are Colour, Taste, Flavour, Appearance, Overall Acceptability, Moisture, Volatile Oil, L*a*b* colour. It was decided that the shelf-life study samples have to be studied based on the sensorial properties initially. The main end of shelf-life parameters are moisture content and water activity and all the other parameters were set to enable better decision making and conclusions on its shelf life. In order to go ahead with shelf-life studies, it was necessary to study the behaviour of blended spices in accelerated conditions and compare the degradation with reference samples.

Statistical Analysis:

Since the number of replications for the analysis is confined to three (n=3), the values are represented as Mean ± Standard deviation.

Table 1
Process conditions of the experimental study

Storage condition (Accelerated)	40ºC, 75% RH
Storage condition (Ambient)	30ºC, 65% RH
Roasting conditions	80ºC, 10 minutes
Products	Sabji Masala, Mutton Sukka Masala
Duration of storage	3 Months (Accelerated), 9 Months (Ambient)

Table 2
Experimental design for accelerated study

Conditions: 40ºC and 75% RH for 3 months (Stability Chamber)			
Zero Day Testing Parameters-Sensory tests, Moisture, Volatile oil, water activity, L*a*b* values			For a period of 3 months, every 15 days, single sample of each will be collected from the stability chamber and analyzed in triplicates for the decided parameters given.
Every month pull out - 4 Samples			
Packaged units	Blended spices-4	250g each	

Table 3
Experimental design for ambient study

Conditions: 30ºC and 65% RH for 9 months (Ambient-Validation studies)			
Zero Day Testing Parameters-Sensory tests, Moisture, Volatile oil, water activity, L*a*b* values			For a period of 9 months, every 30 days, single sample of each will be collected and analyzed in triplicates.
Every month pull out - 4 Samples			
Packaged units	Blended spices-4	250g each	

Censoring of Samples:

For accelerated conditions, study ends for 90 days. For ambient conditions, study ends for 270 days. All the samples were subjected to sensory analysis and the sensory panel has given cut off points for the shelf life on the basis of certain sensory parameters like colour, taste, appearance, flavour and overall acceptability. Each product exhibited different failure times and is given in table 4.

Ambient Storage Study:

The survival data for unroasted sabji masala at ambient conditions indicates that the product is less stable with volatile oil majorly rather than other chemical parameters.

The survival data for roasted sabji masala indicates that the product at ambient conditions has increased its moisture and decreased its volatile oil content.

Moisture:

Unroasted forms possessed higher moisture values ranging from 8.17 to 9.5%. Roasted forms exhibited moistures in the range of 6.91 to 8.34%. Thus a conclusion can be drawn that roasted sabji is less hygroscopic than unroasted sabji. Variation in chemical composition in different spice mixes has been reported as in the range of 5.1 to 9.2% in channa masala (Kalra et al., 1998).

Volatile Oil:

Unroasted forms exhibited volatile content as in the range of 0.75 to 0.58% and roasted forms exhibited from 0.76 to 0.69%. Sensory panel has reported improved aroma for roasted forms than unroasted forms. Thus a conclusion can be drawn that volatile oil content is directly proportional to the aroma improvement in sabji masala.

Water Activity:

Water activity levels for unroasted sabji masala at ambient conditions has been ranged from 0.474 to 0.559. Roasted forms have exhibited 0.392 to 0.483. Compared to unroasted forms, roasted forms have lower water activity. Similar observations have been observed by Vinod Kumar Modi, (2014) as in the range of 0.52 to 0.54 for pre-processed spice mixes.

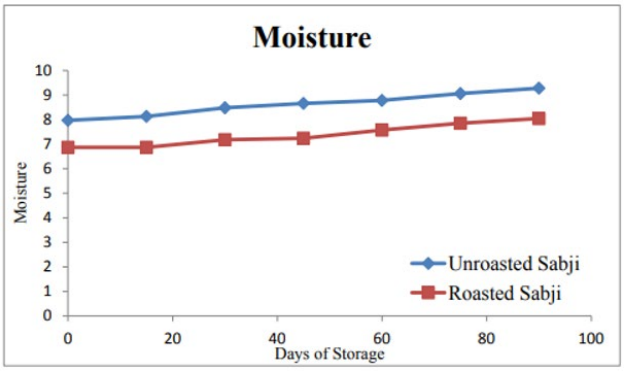

Fig. 1. Observed values of moisture for sabji masala at ambient conditions

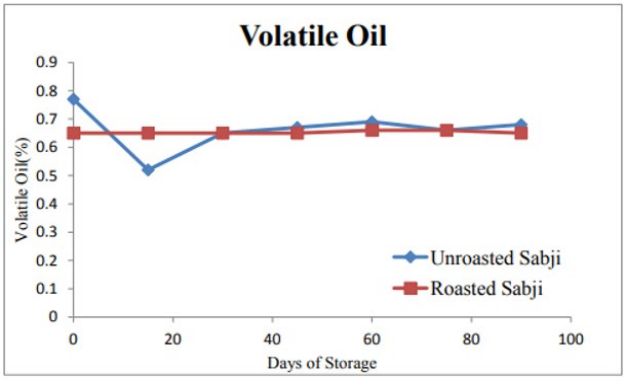

Fig. 2. Observed values of volatile oil for sabji masala at ambient conditions

Table 4
Sensory failure times for experimental samples

S.No.	Name	Accelerated (Days)	Ambient (Days)
1	Unroasted Sabji Masala	75	225
2	Roasted Sabji Masala	90	270
3	Unroasted Mutton Sukka	75	180
4	Roasted Mutton Sukka	60	270

Table 5
Survival data for unroasted sabji masala at ambient conditions

Parameter	0 DAY	45 DAY	90 DAY	135 DAY	180 DAY	225 DAY	270 DAY
Moisture	8.20 ± 0.03	8.58 ± 0.015	9.15 ± 0.04	9.25 ± 0.05	9.31 ± 0.03	9.47 ± 0.02	9.55 ± 0.05
Volatile oil	0.77 ± 0.01	0.64 ± 0.01	0.57 ± 0.03	0.56 ± 0.02	0.6 ± 0.02	0.64 ± 0.03	0.59 ± 0.01
Water Activity	0.48 ± 0.003	0.51 ± 0.003	0.54 ± 0.01	0.57 ± 0.002	0.57 ± 0.004	0.57 ± 0.004	0.572 ± 0.004
L value	45.14	45.08	45.07	44.82	44.56	44.25	44.54
a value	19.38	19.19	19.28	19.16	18.6	18.76	18.72
b value	41.43	41.43	43.22	43.17	43.02	43.23	43.12

Values indicates Mean ± Standard deviation

Table 6
Survival data for roasted sabji masala at ambient conditions

Parameter	0 DAY	45 DAY	90 DAY	135 DAY	180 DAY	225 DAY	270 DAY
Moisture	6.92 ± 0.06	7.28 ± 0.015	8.26 ± 0.03	8.37 ± 0.02	8.56 ± 0.04	8.25 ± 0.03	8.36 ± 0.02
Volatile oil	0.76 ± 0.02	0.67 ± 0.015	0.68 ± 0.01	0.67 ± 0.02	0.74 ± 0.02	0.72 ± 0.02	0.68 ± 0.01
Water Activity	0.390 ± 0.003	0.45 ± 0.002	0.44 ± 0.002	0.457 ± 0.004	0.47 ± 0.002	0.493 ± 0.002	0.484 ± 0.002
L value	43.98	43.03	42.93	42.67	42.84	42.89	42.01
a value	19.19	18.77	19.26	19.86	19.23	19.92	19.84
b value	39.01	38.9	40.49	41.2	40.89	40.62	40.83

Values indicates Mean ± Standard deviation

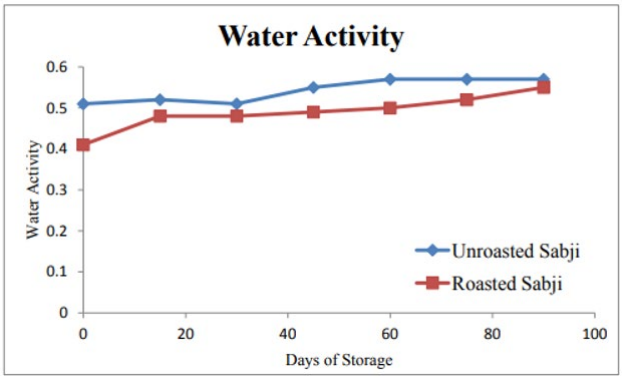

Fig. 3.

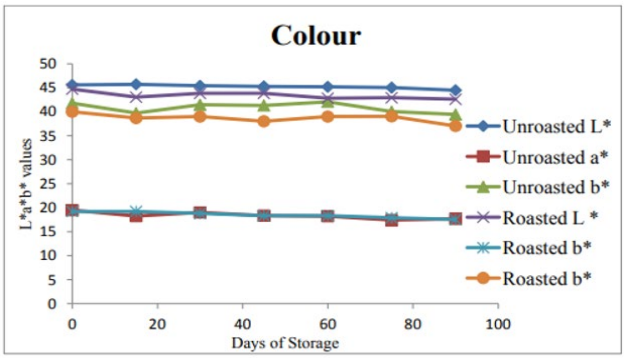

Fig. 4. Observed values of colour for sabji masala at ambient conditions

4. Conclusion

Shelf-life studies were conducted for sabji masala, in both roasted and unroasted forms. Observations from the study clearly demarcated the difference between roasted and unroasted forms. Roasted forms are more stable with moisture, volatile oil, colour and water activity compared to unroasted forms. Roasted forms of all the experimental samples are more palatable and are accepted over unroasted. Sabji masala in both forms has improved aroma upon storage but surface colour has changed.

Under accelerated conditions (37 ºC ± 2 ºC, 75% RH) shelf life of unroasted sabji based on sensory score is 75 days, for roasted forms it is 90 days. Whereas under ambient conditions (27ºC ± 2 ºC, 65% RH) unroasted sabji masala is stable up to 225 days and roasted form up to 270 days. All the samples are within the standards prescribed by the Food Safety Standards Authority of India. In the current study temperature and humidity are taken as accelerating factors. But future work has to be initiated by including light also as an accelerating factor, since loss of colour is observed in all samples. Increasing the thickness of the current packaging material may define a solution to the colour loss and aroma loss of the samples. Addition of anti-caking agents like silicon dioxide in the prescribed limits may decrease the caking phenomenon in all samples.

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