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Development of ready to cook curry mix enriched with vegetable protein

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Abstract
Convenience is a multifaceted concept and often listed as the most important factor that determine the food of choice apart from the cost, health, sensory acceptability and related concerns and which is easy and fast to prepare but all these preparations need value addition ultimately to improve the nutritional value. Defatted sesame meal is rich in amino acids, proteins, fiber and it contains 48% protein. The present study was carried to develop ready to cook curry mix using vegetables, spice mix and enriched with sesame oilcake and six formulations were done. The prepared product samples were evaluated for sensory evaluation, physico-chemical analysis and shelf life. When sensory qualities among different formulation were evaluated, sample 101 got significantly higher values for overall acceptability. The formulation 102 was found good and followed by 602, 402 in both sensory and nutritional analysis Instant soup mix did not reveal any pathogenic organism when it is stored for 2months in laminated pouches under normal room condition.

Keywords: Amino acids, proteins, fiber

Introduction
A modern lifestyle of many Indian people today especially living in big cities needs fast paced and practical things almost as in all aspects, including preparation, packaging and consumer preferences of food. It develops a society who loves instant food products such as foods that are Ready to Cook (RTC) and Ready to Eat (RTE) convenience foods such as soup mixes, instant breakfast foods like upma, idly, dosa and others like pulihora mix have been developed. Thus, there is a need to develop suitable technology for the development of Ready to Cook vegetable curry mix enriched with vegetable protein.

Ready to Cook foods are processed or prepared foods in which very little additional efforts and requires less time. These foods are sold as dry mixes. They are prepared by reconstitution. It involves water or other basic liquids commonly sold, i.e., juices, milk, broth, etc. The heat is required for reconstitution. The commercial process to manufacture these dry mixes usually involves the blending of several ingredients prior to packaging. In this study the product is an instant vegetable curry mix enriched with vegetable protein. This curry mix contains defatted sesame oil meal high in protein, vegetables that are rich in β-carotene/vitamin A, capsicum a good source of vitamin A and free of cholesterol, low in sodium and calories. (Rakesh Sharma and V.K. Joshi, 2014) [17], tomato contains lycopene, ginger, garlic rich in antioxidants, herbs like cilantro and mint and some other spice powders.

As it is a dehydrated product which has major advantages as protective from oxidative spoilage and can have flavor stability up to six months at room temperature. It is a cheap vegetable protein that is available in market and can incorporate in any fresh and processed curry mixes to the final product nutritive value.

Defatted sesame meal is rich in amino acids, proteins, fiber. Bioavailability of protein is more about PER in sesame meal to be 1.35 in rats (ref R. Yasothai, 2014) [22]. Depending on the type of oil extraction, expeller sesame meal has a protein content of about 45% of DM, ranging from 32 to 53%, whereas solvent extracted sesame meal contain about 48% protein (R. Yasothai, 2014) [22]. The metabolic energy in deoiled sesame meal was found to be 2600 Kcal/kg (Pathak and Kamra, 1989) [15]. This curry is prepared by soaking curry mix for 10 minutes in water and cooking in a pan for 10 to15 minutes at a temperature of 120 ^{0}C.

The objective of this study is to develop Ready to cook vegetable curry mix enriched with vegetable protein and to determine physico-chemical properties of Ready to cook vegetable curry mix enriched with vegetable protein.

Methodology

Procurement of raw material

The materials used for the preparation of instant vegetable curry mix enriched with vegetable protein are sesame oil cake, carrots, capsicum, tomato, onion, ginger, garlic, red chili flakes, amchur (dry mango powder), spice powders like cinnamon, cardamom, black pepper, clove, cumin and additives like black gram flour and rice flour are purchased from market in Pulivendula town.

Preparation of ingredients

Carrots are cut into small pieces, dip blanched and dried in cabinet solar drier. Capsicums are washed, cut, removing seeds, steam blanching and shade dried. Ginger are washed, peeled, cut into pieces, steam blanched and then sun dried. Garlic are washed, peel is removed, cut into pieces, steam blanched and sun dried. Tomatoes are washed, peeled, seeds are removed cut into pieces, blanched and sun dried. Onions are peeled out, cut into pieces, dip blanched and sun dried. Mint and Cilantro leaves are washed, steam blanched and shade dried.

Table 1: Blanching time and temperatures of different vegetables

S. No	Vegetables	Blanching media	Blanching time(min)	Temperature
1	Carrot	Water	4	80-100 ºC
2	Capsicum	Steam	4	90-95 ºC
3	Onions	Steam	4	85-90 ºC
4	Tomato	Water	2	80-85 ºC
5	Ginger	Steam	4	90-95 ºC
6	Garlic	Steam	4	80-90 ºC
7	Mint	Steam	4	80-85 ºC
8	Cilantro	Steam	4	80-85 ºC

Source: P. Kendall *et al*. Drying Vegetables

Preparation of rice and black gram flours:

Rice is soaked for 3-4 hours, shade dried till there is water loss roasted and then made into flour. Black gram is soaked for 3-4hrs, cleaned, shade dried and made into flour.

Preparation of spice powders

Cardamom, cumin, clove, cinnamon, black pepper (5 spice powders) are roasted separately and ground into powder. Roasting improves the flavor and volatile compounds. Chilli flakes are made first by blanching the ripened red chillies for 2 min at 85 ºC and then solar dried. For formulation of RTC curry mix processed dry mango powder is used.

Preparation of sesame cake

Sesame cake is roasted prior to use as roasting improves the flavor of the cake.

Preparation of curry mix

All the ingredients are mixed in different proportions and packed in air tight LDPE pouches. While consuming the pack should be opened and soaked in water for 20 minutes and cook for 10 minutes.

Organoleptic analysis of curry mix

Organoleptic evaluation of curry mix was carried out using 9point hedonic rating scale was used for comparing different samples of curry mix. Sensory evaluation was carried out by 10 panelists. Samples were tested for parameters like flavor, appearance, taste, texture and overall acceptability panelists. Samples were tested for parameters like flavor, appearance, taste, texture and overall acceptability.

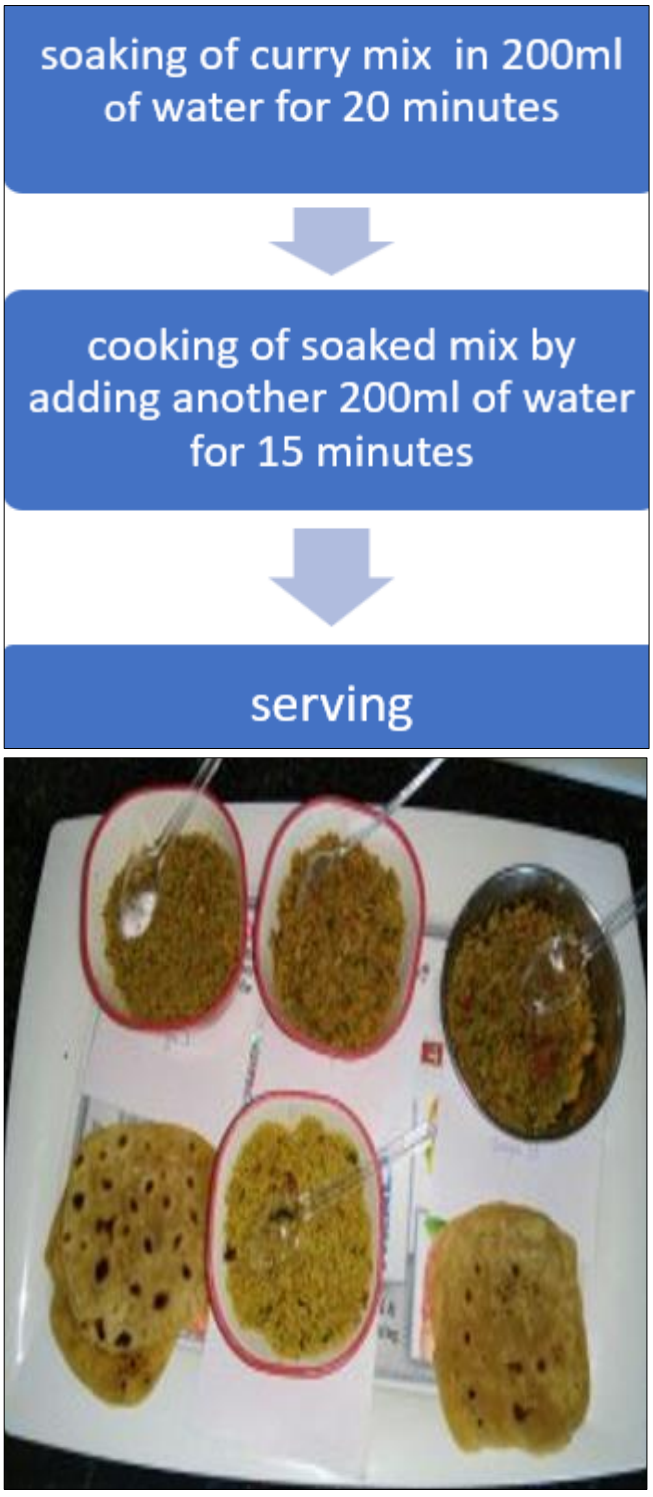

Fig 1: RTC curry mix

Physico-chemical analysis

Moisture content

It is based on the separation of water from the food material and it's measurements by the resulting loss in weight or by measurement of amount of water separated. The removal of water can be accomplished by drying procedure. Weigh 5 g of sample along with petri dish and lid. Leave the petri dish in an oven at 100º-105 ºC with the lid open for about 15-17 hours.

Cool the petri dish in a dessicator the closed for 1-2hours. Weigh the petri dish and note. Repeat the process of heating and cooling till a constant weight is achieved. (Manickam) 2004 [3].

$$\frac{\text{initial weight of sample} - \text{final weight of sample}}{\text{initial weight}} \times 100$$

pH

pH is defined as logarithm of reciprocal of hydrogen ion concentration in grams per liter. It is important as the measure of the active acidity which influences the flavor or palatability of a product and effects the processing requirements. For determining the pH of curry mix generally a buffer of pH 4 would be sufficient. Standardize the pH meter using this buffer and check the pH of the sample. Ranganna. (1994) [29]

Total soluble solids

The instrument used for determining the total soluble solids is by hand Refractometer. First rinse the prism of Refractometer with distilled water and calibrate with it. As the sample is a powder add water to the mix and now determine the Refractometer reading placing a drop of mix on the prism and read the corresponding percentage of dry substance or total soluble solids. Ranganna (1994) [29].

Titratable acid

It is necessary to determine the acidity of a given food sample to ensure the presence of acids in terms of predominant acid present in it. It is done by titrating the sample against standard NaOH (0.1N) in presence of indicator. 5g of each sample is taken into 100ml volumetric flask and make up to the mark with distilled water. The 25 ml of aliquot of the sample is taken into conical flask, 2 drops of phenolphthalein indicator is added and titrated with standard NaOH. Appearance of pale pink color indicates the endpoint. Note the titrate value and calculate the acidity in terms of citric acid. Ranganna (1994) [29].

$$\frac{\text{titre} \times \text{normality of NaOH} \times \text{volume made up} \times \text{eq. wt of acid} \times 100}{\text{volume of sample taken for estimation} \times \text{wt of sample taken} \times 1000}$$

Total Carbohydrates

In hot acid medium glucose is dehydrated to hydroxymethyl furfural. This forms a green colored product with the phenol and has absorption maximum at 490nm. The total carbohydrates were determined by using phenol sulphuric acid method. Sadasivam, (2008) [28].

Protein Content

The nitrogen in protein or any other organic material is converted to ammonium sulphate by sulphuric acid during digestion. This salt, on steam distillation, liberates ammonia which is collected in boric acid solution and titrated against standard acid. Since 1ml of 0.1N acid is equivalent to 1.401 mg N, calculation is made to arrive at the nitrogen content of the sample. Total protein was determined by using Kjeldahl method. AOAC (2008). The crude fat, ash was determined by using AOAC (2008) methods.

Determination of energy

Energy value of the sample is calculated by multiplying the figure for percentage of protein, fat and carbohydrate by 4, 9 and 4 respectively. Ranganna (1994) [29].

Calorific value (kcal)=(% protein × 4)+ (% fat × 9) + (% carbohydrate × 4)

Microbial analysis

Microbial analysis is important to find out the shelf life of developed soup mix powder and there by ensure the safety of the Product. The sample of 10 g was dissolved into 90ml of dilution blanks and subsequent number of sample suspension was serially diluted up to 10^{-5} dilutions. 0.1ml of dilution from each of the series of test tubes ranging from 10^{-1} to 10^{-5} was placed on the solid medium following spread plate technique and incubated at 37 ^{o}C for 24 to 48hrs for bacterial and fungal count. The average of microbial count was recorded as colony forming unit per ml (CFU/ml). The media used for isolation included Nutrient agar was used to identify bacillus and other bacterial species and Potato dextrose agar was used for fungal identification.

$$\textbf{No of colonies (cfu/ml)} = \frac{\textbf{no of colonies formed}}{\textbf{dilution factor} \times \textbf{vol of sample for spreading}}$$

Results

Before mixing all ingredients sesame meal, vegetables and other spices were standardized in order to optimize formulations for sensory analysis. The sesame meal was kept to 66.6% (Sample102), 50% (sample 202, 302, 402, 502, 602), and remaining ingredients varies from one sample to another. The data regarding the variance of ingredients on an organoleptic quality of Ready to cook curry mix have been represented in the table 2. In the formulation of curry mix.

Table 2: Standardization of formulation of Ready to cook curry mix enriched with vegetable protein.

Ingredients in grams	102	202	302	402	502	602
Sesame meal	50	50	50	50	50	50
Carrot	13.3	10	10	10	13.3	10
Capsicum	6.6	10	10	10	6.6	13.3
Tomato	2.6	`10	10	10	6.6	10
Onion	2.6	2	6.6	0.3	1.0	0.3
Ginger	0.4	1	0.6	0.6	1.0	0.3
Garlic	0.2	1	0.6	0.1	0.3	0.6
Salt	4	4	4	6.6	6.6	6.6
Chilli flakes	1.3	6	5	5	3.3	3.3
Cilantro	0.2	0.2	0.6	0.6	0.3	0.3
Mint leaves	0.2	0.2	0.3	0.3	0.3	0.3
Turmeric	1.3	0.2	0.3	0.3	0.3	0.6
Clove	0.2	0.2	0.03	0.3	0.3	0.3
Cumin	0.2	0.2	0.3	0.6	0.3	1.0
Pepper	0.2	0.2	0.3	0.3	0.3	0.3
Cinnamon	0.1	0.2	0.3	0.3	0.3	0.3
Cardamom	0.1	0.2	0.3	0.3	0.3	0.3
Amchur powder	0.6	0.2	0.3	0.6	2.0	0.3
Additives (Rice + bengalgram flour)	-	6	4	8	4	6

Moisture content

Moisture content for Ready to cook curry mix enriched with vegetable protein for all samples ranges in between 2.0 to 2.10 % have been represented in the table 3 similar to the moisture content of coconut chutney mix having moisture content 2.5 to 2.6% stated by Vennila *et al*., (2010) [16].

pH

It was observed that pH of the samples ranges in between 5.2 to 5.3 have been represented in the table 3 is similar to the pH of Coconut chutney mix having pH range of 5.2 to 5.3 stated by Dr. P. Vennila *et al.* (2010) [16].

TSS

Total soluble solid of the Ready to cook curry mix ranges in between 2 to 3 have been represented in the table 3 which is lower than the Instant curry mix of range 3.14 to 4.5 stated by SV Karadbhajne *et al*.,2017 [25].

4.2.4. Total Carbohydrates

Total Carbohydrates percentage of samples ranges in between 53 to 62 % have been represented in the table 3 which is comparatively more than the coconut Chutney Mix stated by Dr. P. Vennila *et al*., (2010) [16]. The carbohydrate content is more in 402 sample due to the addition of more quantity of vegetables when compared to other samples.

4.2.5. Crude Fat

Composition of Fat for samples ranges in between 3 to 6% have been represented in the table 3 which is comparatively similar to the fat composition of defatted sesame oil cake as stated by Ranganayaki, S. *et al*., (2012) [19]. Slight variation is due to the variation in quantity of oils in spices.

Protein composition

Protein composition of samples is ranges in between 23 to 27% for samples have been represented in the table 3 which is more than Dried Vegetarian Soup supplemented with Some legumes (7 to 14%) stated by Amal M.H. Abdel-Haleem *et al*., 2014 [2]. The protein content is high in 402 due to the addition of more amount of Bengal gram flour.

Ash content

Ash content of all samples ranges from 9.05 to 10.70% have been represented in the table 3 which is less than ash content of the instant herbal soup mix developed by Shuchi Upadyay *et al*., 2017. The ash content is more in sample 602 due to more amount of vegetables which provides more minerals.

Organoleptic evaluation

Table 4: Sensory scores of Ready to cook curry mix enriched with vegetable protein

Sensory parameters	Selected samples with high sensory score					
	101	**202**	**302**	**402**	**502**	**602**
Appearence	8.3	8.0	7.4	6.7	7.3	7.8
Flavour	8.0	8.0	7.0	5.6	6.3	7.6
Texture	7.8	8.0	7.0	7.7	6.5	8.1
Taste	8.5	7.8	7.1	6.4	6.6	7.3
Overall acceptability	8.6	7.8	7.7	6.7	7.6	7.8

The score for taste found highest in the sample 101 i.e., 8.5 when compared to other samples which is formulated without additives (rice+ Bengal gram flour). Score for flavor of curry mix is more for 602 i.e., 7.6 when compared to other samples. The score for color is found highest in 101 i.e., 8.3 and over all acceptability found highest in 101 i.e., 8.66 when compared to other samples.

Table 3: Physico-chemical characteristics of Ready To Cook vegetable curry

Samples (100 gms)						
Parameter	101	202	302	402	502	602
Moisture content (%)	2.003	2.92	2.6	2.82	2.1	2.06
pH	5.31	6.05	6.06	5.66	5.60	5.05
TSS(^{0}brix)	3.2	2.5	2.0	2.5	2.5	2.6
Titratable acid (%)	0.53	0.81	0.44	0.23	0.25	0.20
Total solids (%)	98.07	99.7	97.55	97.55	97.72	97.50
Carbohydrates (%)	58.42	59.85	61.48	53.11	60.78	58.07
Protein (%)	25	24.02	23.05	26.98	24.52	25.68
Fat (%)	4.05	4.05	3.45	4.0	3.55	3.9
Ash (%)	10.52	9.16	9.42	10.49	9.05	10.70
Calorific value(%)k.cal	370.13	371.93	369.17	379.76	373.15	370.1

Microbial analysis

The deterioration of ready to use curry mix prepared from vegetables and sesame oil cake is given in table (5). Most significant changes in curry mix is due to the biological factors rather than physical and chemical factors. The bacterial population of curry mix was found after three months. Jayadeepa (2002) reported that the bacterial population ranged from 6.0-5.0×10^3/g and 4.0-2.0×10^3/g respectively in Kurma and gravy mixes. Similar bacterial population was noted in Ready to cook Curry mix enriched with vegetable protein.

Table 5: Microbial count (CFU/g) of RTC curry mix enriched with vegetable protein

Sample	101	202	302	402	502	602
Microbial count (CFU/g)	4 × 10^3	3×10^3	3×10^3	3×10^3	5×10^3	5.5×10^3

Summary

The present study was conducted on "Development of Ready to cook curry mix enriched with vegetable protein". The Ready to Cook Instant curry mix which is having different proportions of dried vegetables (capsicum, carrot, tomato) enriched with sesame meal. The sensory analysis was conducted by proving the samples to the sensory evaluators. From the result given by evaluators found that samples 101 has superior organoleptic qualities followed by 402, 602 when compared with other samples. By physico-chemical analysis the results were observed that the sample 101 contain carbohydrates (58.42), protein (25), fat (4.05) and calorific value (370.13 Kcal). Formula diet with rich in essential nutrients is demand of present lifestyle. The ready to cook instant curry mix enriched with vegetable protein is clearly studied that the usefulness of

supplementing reasonable source of protein (RDA 25% per day), carbohydrates, vitamins and minerals and there is no addition of preservatives having shelf life up to 3 months.

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