

Formulation, Standardisation and Quality Evaluation of Jujube Fruit Powder Incorporated in Rusk, Crackers and Masala Cookies

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Abstract: *Jubae Fructus, the Ziziphus jujuba Mill (Rhamnaceae) fruit, also known as jujube, or Chinese date, or red date, has been popularly used for more than 3,000 years as a food and Chinese herbal medicine. The aim of the study is to formulate and standardise a new product using Jujube Fruit powder and it was incorporated in Rusk, Crackers and Masala Cookies. Jujube fruit powder was incorporated in Rusk, Crackers and Masala Cookies in four variations like Sample A-5g, Sample B- 10g, Sample C-15g and Sample D-20 g respectively. They were subjected to sensory evaluation and the best product was selected. The standard and selected best products were analysed using Sensory analysis, Nutrient analysis, Microbial analysis and Statistical analysis. The selected best product shelf life study was analysed using two different packaging materials like Zip lock cover and Airtight container for a period of 7 days interval. Nutrient analysis is essential for a new product formulation. Since Jujube fruit has a high amount of protein and fiber, these two nutrients were analysed. Cost calculation was done to the jujube fruit powder incorporated best products and compared with the standard products. The products were consolidated by using statistical tools like Mean, Standard deviation and ANOVA. ANOVA was done for the Sensory attributes. The best products were found out of it and popularized among Adults as they are facing many metabolic diseases and this fruit is very useful in such conditions.*

Key Words: *Jujube fruit powder, Rusk, Crackers, Masala Cookies, Popularisation (Adults).*

1. INTRODUCTION:

Food is any material ingested in order to provide the body with nutritional help. It is typically of animal or plant origin and includes important nutrients such as fats, proteins, minerals, carbohydrates or vitamins. The material is ingested by an organism and assimilated by the organism's cells in an effort to produce energy, sustain life or stimulate growth (Peter Hazell and Stanley Wood, 2008). The complete process of bringing a new product to market is new product development (NPD). The quality of the products is described in the literature as the transformation of a market opportunity into a product available for sale and it can be tangible, that is, something physical or intangible that you can touch, such as for a service, experience or belief (M Earle R Earle A Anderson, 2001). Recent phytochemical and pharmacological findings have shown that the main active ingredients of the anti-oxidative activity of jujube are flavonoid, polysaccharide, and triterpenic acid. The key active ingredients contributing to its immune-modulating and hematopoietic roles were also suggested to be Jujube polysaccharides. Triterpenic acids have been considered to be the active ingredients for anti-inflammatory and anti-cancer effects. Betulinic acid and jujuboside B may also be active ingredients that have beneficial effects on the cardiovascular system. Jujube is regarded, according to Chinese medicinal theory, as a medicinal herb that calms the mind and relieves mental stress. Clinically, jujube is widely used for the treatment of insomnia and forgetfulness, either as a single herb or in tranquilizing formulations mixed with other herbal medicines. For brain defense, a study was done by supplementing Jujube berries (Ángela Carbonell, 2007).

2. OBJECTIVES:

The present study was aimed on “Formulation Standardisation, Quality Evaluation and Nutrient Analysis of Jujube Fruit Powder Incorporated in Rusk, Crackers and Masala Cookies” was studied under the following objectives;

- To formulate, standardise and evaluate the sensory attributes of jujube fruit powder incorporated rusk, crackers and masala cookies.
- To analyse the shelf life study of selected products along with the standards.
- To evaluate the nutrients especially protein and fiber.
- To popularize the newly formulated products among Adults.

3. LITERATURE REVIEW:

"To exist is to change, to change is to mature, to mature is to go on endlessly creating one self," as Bergson said. This saying is valid not only for persons, but also for a service or product. Technologies change in an ever-changing environment, consumer needs change, ecosystems change, rivals change, and as all this changes, if the product/service stays the same, It is going to cease to exist. Therefore, new product development and updating of existing goods must be actively sought. New Product Creation can have a radically different experience for the client. It should break down the clutter and separate your brand from others. Customer needs continue to grow rapidly today, compressing product life cycles. Production of goods is not a simple process. The success rate varies from 45 percent to 62 percent. There are different product development models to increase the success rate, which may aid companies in their search to produce new products (Edgett, S. J., 2010). In India, Russia, Southern Europe, China and the Middle East, jujube, also known as ziziphus, is grown and cultivated. The fruit has been used for over 4,000 years in Chinese medicine. The jujube fruit is cultivated for only a few niche markets in India. The key minerals found in Jujube fruit are potassium, phosphorus, manganese and calcium. A high concentration of sodium, zinc, iron and copper is also present. Vitamin C, riboflavin and thiamine are also included in Jujube fruit. The fruit's vitamin and mineral content helps to promote cardiovascular health and improve metabolism (Emir. J. Food Agric., 2013). Jujubes make an excellent, healthy snack owing to their high fiber content and low calorie count. They contain small amounts of several vitamins and minerals, but they are especially rich in vitamin C, an important antioxidant and immune-boosting vitamin. They also contain a fair amount of potassium that plays a vital role in muscle control, and jujube fruits also contain carbohydrates that provide your body with energy in the form of natural sugars. Dried jujubes however are much higher in sugar and calories than fresh fruit, which are more commonly eaten and used in cooking in many parts of the globe. Several antioxidant compounds, mainly flavonoids, polysaccharides, and triterpenic acids, are rich in jujube fruits. They also contain high vitamin C levels, which also act as an antioxidant (C.M.D. Man and Adrian A. Jones, 2000).The transfer of moisture and water vapor acts as a key factor affecting shelf life (Catriona et.al.,2004). Physicochemical changes in food during storage can cause loss of shelf-life resulting deterioration of its quality. Sensory assessment is defined as a scientific method used by the senses of sight, smell, touch, taste and hearing to evoke, measure, analyze and interpret these responses to products perceived. Rheology in sensory assessment is used in food engineering as an essential design tool as it is essential for processing, shelf stability and sensory perception, including texture and mouth feeling. It can probe the overall structure as well as the interplay between individual colloidal components (Singham P,et.al., 2015)

4. MATERIALS AND METHODS:

4.1. Selection of ingredient:

Jujube fruit powder was selected as an ingredient since it is rich in nutrients like Protein, Fibre, Vitamin A, Vitamin C and it has many functional properties. It was purchased from the local market.

4.2. Preparation of jujube fruit powder:

The fruit were cleaned, grated and kept under sunlight for drying. The dried fruit were powdered.

4.3. Selection of product:

Rusk, Crackers and Masala Cookies were selected as the products.

4.4. Formulation and Standardization:

Standardization was done by incorporating the Jujube fruit powder in specific proportion. The selected Rusk, Crackers and Masala Cookies were incorporated by substituting Jujube fruit powder in the standard recipe with the proportion of 5%, 10%, 15% and 20% in Sample A, Sample B, Sample C and Sample D respectively. In the product formulation four variations along with standard was taken for the sensory evaluation. Table 1 indicates the level of incorporation of Jujube fruit powder in selected product.

Table 1
Jujube fruit powder incorporated in different variations

Variations	Maida Flour	Jujube fruit powder
Standard	100g	-
Sample A	95g	5g
Sample B	90g	10g
Sample C	85g	15g
Sample D	80g	20g

4.5. Sensory Evaluation:

The standardized products were evaluated for its sensory attributes using a score card with 5 point scale. The criteria included in the score card were appearance, colour, flavour, texture and taste. Sensory analysis was conducted in a clean, undisturbed environment between 11.00am and 3.00pm. Score card was used to evaluate. The evaluation was done by 30 semi- trained panel members of staffs and students from Department of Foods and Nutrition in Rathnavel Subramaniam College of Arts and Science.

4.6. Selection of best product incorporation:

Sensory quality is a combination of different senses of perception coming in to play choosing and eating a food. The overall quality of the product depends on the nutrition and sensory quality assessed by human sense organs. The most acceptable proportion was selected through appearance, colour, flavour, texture and taste. After sensory evaluation, from the different variations Sample D from Rusk, Sample A from Crackers and Sample C from Masala Cookies was selected as the best product.

4.7. Nutrient analysis:

Food Nutritional Analysis is needed to produce nutrition fact labels. Foods processing also require lab testing. Nutrient analysis refers to the process of determining the nutritional content of foods and food product (K.Chowdhury,et al., 2012).Since Jujube fruit has a high amount of protein and fiber so these two nutrients were analysed

4.8. Shelf life Study:

Shelf life study was done to find the longevity of the products so that the consumers could consume it for maximum number of days. Shelf life of any food product depends on moisture content, preparation method, preservatives added and packing material used. To determine the time a product can be expected to keep without appreciable change in quality, safety or character.

4.9. Packaging Material:

The product was packed in two different packaging materials like Ziplock cover and Air tight container. The selected products were stored in both packaging materials in room temperature and observed for 15 days to find out its better shelf life. The storage stability of the products will depends on the preparation method, ingredients used and the moisture content. The stored products were analyzed for their sensory attributes by the same panel members on 1st day, 8th day and 15th day for a period interval of 7 days.

4.10. Microbial Analysis:

Microbial analysis was conducted to check the growth of mold, fungus, and to find the total bacterial count at room temperature. One sample was selected as best product among four variations and along with standard the selected samples were subjected to microbial analysis. The microbial test was carried out on 1st, 8th and 15th day respectively to assess the microbial count for both standard and selected best product.

4.11. Cost Analysis:

The cost estimation was done to compare the price of standard product and the formulated product. The cost of the ingredient was calculated according to the availability in the local area.

4.12. Popularisation:

Health promotion is an important focus in the present health care environment. As the population ages, the potential strain on health care systems will increase because the greatest use of health care services occurs during the last years of life (Ronni Chernoff, 2001). Popularisation was done among Adults. It was done for 30 subjects using a questionnaire method. The subjects were asked to fill the questions before and after giving nutrition education. It consists of 15 questions which were given to the subjects. This helps to know the importance of popularising a product.

4.13. Statistical Analysis:

The data collect were consolidated and statistically analyzed using the statistical tools like Mean, Standard Deviation and ANOVA. Mean is the simplest measurement of central tendency. Its chief use consists in summarizing the essential features of a series and in enabling data to be compared. Standard deviation is defined as the square root of the average of squares of the deviation, when such deviation for the values of individual items in a series are obtained from the arithmetic average. Analysis Of Variance (abbreviated as ANOVA) is an extremely useful technique concerning researchers in the field of economics, biology sociology, physiology and of other several disciplines. This technique is used when multiple cases are involved

5. RESULT AND DISCUSSION:

5.1. Comparison of standard with the selected product:

The mean sensory score for the overall acceptability of the standard products was obtained by the sensory evaluation using scorecard. It is clear that among the prepared products, Sample D from Rusk, Sample A from Crackers and Sample C from Masala Cookies had the highest mean score in all the criteria when compared to other

samples. So that we can conclude that these samples were selected as the best products. Table 2 depicts the comparison of the sensory attributes of the selected jujube fruit powder incorporated rusk, crackers and masala cookies with the standard products

Table 2

Comparison of mean scores for standard and selected proportion of jujube fruit incorporated products						
Criteria	Rusk		Crackers		Masala Cookies	
	Standard	Sample D	Standard	Sample A	Standard	Sample C
Appearance	4.86±0.33	4.33± 0.86	4.9±0.35	4.8±0.47	5±0	3.9±0.78
Color	4.83±0.37	4.53±0.713	4.93±0.24	4.83±0.45	4.8±0.47	4.76±0.49
Flavour	4.96±0.17	4.43±0.88	4.93±0.24	4.83±0.37	4.8±0.47	4.5±0.67
Texture	4.7±0.45	4.63±0.603	4.9±0.3	5±0	5±0	5±0
Taste	5±0	4.73±0.51	5±0	5±0	4.96±0.17	4.96±0.17

From the above table it was noted that the selected best products had no big difference in their scores when compared with the standard products.

5.2. Nutritional analysis of jujube fruit powder incorporated in selected products:

Jujube fruit is low in calories but rich in fiber, vitamins and minerals. A 3-ounce (100-gram) serving of raw jujube, or about 3 fruits, provides Calories: 79 kcal, Protein: 1g, Fat: 0g, Carbohydrates: 20g, Fiber: 10g, Vitamin C: 77% of the Daily Value (DV) and Potassium: 5% of the Daily Value (DV). Due to their high fiber content and low calorie count, jujubes make an excellent healthy snack. There is a remarkable change in nutrients like protein and fibre after incorporation of jujube fruit powder to the selected products when compared to the standard product. So nutrients like protein and fibre was analysed for further study. Table 3 depicts the comparison of nutritive values for standard and selected proportion of jujube fruit powder incorporated rusk, crackers and masala cookies.

Table 3

Comparison of nutritive values for standard and selected proportion of jujube fruit powder incorporated products						
Nutrients	Rusk		Crackers		Masala Cookies	
	Standard	Sample D	Standard	Sample A	Standard	Sample C
Protein	9.2g	12.6 g	6.8g	10.1g	6.1g	9.7g
Fibre	0.2g	1.4g	1.6g	3.1g	0.6g	2.5g

From the above table it was clear that after the incorporation of jujube fruit powder to the sample products there is a remarkable change in nutrients like protein and fiber when compared to the standard.

5.3. Shelf life study of Standard and Selected product:

Shelf life is the recommended maximum time for which products can be stored during which, the defined quality of a specified proportion of the goods remain acceptable under expected conditions of distribution, storage and display. The standard and selected products were analyzed for its shelf life period by evaluating their sensory attributes and total microbial load after packing into air tight container and zip lock cover at an interval of 7 days. It was concluded that the products were safe for consumption till 15th day, if it is stored in proper conditions.

5.4. Sensory Analysis of the Standard and Selected product during Storage Study:

Sensory Analysis of the standard and selected jujube fruit powder incorporated rusk, crackers and masala cookies during storage study kept in Zip lock cover and airtight container was given in Table 4, 5 and 6.

Table 4

Mean score obtained by Standard and Jujube Fruit Powder Incorporated Rusk Stored in Zip Lock Cover

Criteria	1 st day		8 th day		15 th day	
	Standard	Sample D	Standard	Sample D	Standard	Sample D
Appearance	4.9±0.29	4.8±0.22	4.8±0.25	4.9±0.24	4.8±0.44	4.7±0.32
Colour	4.9±0.29	4.6±0.49	4.9±0.20	4.7±0.38	4.9±0.29	4.6±0.49
Texture	4.9±0.24	4.7±0.34	4.8±0.29	4.6±0.49	4.9±0.29	4.6±0.49
Flavour	4.7±0.33	4.6±0.49	4.7±0.35	4.5±0.39	4.6±0.48	4.6±0.45
Taste	4.8±0.21	4.6±0.49	4.9±0.24	4.6±0.49	4.9±0.24	4.6±0.49

Table 4.1

Mean score obtained by Standard and Jujube Fruit Powder Incorporated Rusk stored in Airtight Container

Criteria	1 st day		8 th day		15 th day	
	Standard	Sample D	Standard	Sample D	Standard	Sample D
Appearance	4.9±0.29	4.8±0.23	4.8±0.25	4.8±0.29	4.8±0.44	4.6±0.51
Color	4.9±0.29	4.7±0.38	4.9±0.20	4.7±0.35	4.9±0.29	4.7±0.33
Texture	4.9±0.24	4.8±0.24	4.7±0.29	4.6±0.49	4.8±0.27	4.8±0.26
Flavour	4.7±0.33	4.6±0.46	4.7±0.35	4.6±0.55	4.6±0.48	4.5±0.62
Taste	4.9±0.21	4.7±0.48	4.9±0.24	4.8±0.28	4.9±0.24	4.7±0.34

Table 5

Mean Score obtained by Standard and Jujube Fruit Powder Incorporated Crackers Stored in Zip Lock Cover

Criteria	1 st day		8 th day		15 th day	
	Standard	Sample A	Standard	Sample A	Standard	Sample A
Appearance	4.9±0.29	4.8±0.24	4.8±0.25	4.8±0.24	4.8±0.44	4.7±0.35
Color	4.9±0.29	4.8±0.31	4.9±0.20	4.7±0.40	4.9±0.29	4.8±0.23
Texture	4.9±0.24	4.8±0.28	4.8±0.29	4.7±0.38	4.9±0.29	4.7±0.41
Flavour	4.7±0.33	4.6±0.49	4.7±0.35	4.6±0.44	4.6±0.48	4.6±0.49
Taste	4.8±0.21	4.7±0.32	4.9±0.24	4.7±0.34	4.9±0.24	4.7±0.34

Table 5.1

Mean Score Obtained by Standard Jujube Fruit Powder Incorporated Crackers in Airtight container

Criteria	1 st day		8 th day		15 th day	
	Standard	Sample A	Standard	Sample A	Standard	Sample A
Appearance	4.9±0.29	4.8±0.24	4.8±0.25	4.7±0.39	4.8±0.44	4.7±0.45
Color	4.9±0.29	4.7±0.42	4.9±0.20	4.8±0.34	4.9±0.29	4.8±0.34
Texture	4.9±0.24	4.8±0.30	4.7±0.29	4.6±0.45	4.8±0.27	4.7±0.39
Flavour	4.7±0.33	4.6±0.51	4.7±0.35	4.6±0.46	4.6±0.48	4.6±0.43
Taste	4.9±0.21	4.8±0.24	4.9±0.24	4.7±0.34	4.9±0.24	4.7±0.40

Table 6

Mean Score obtained by Standard and Jujube Fruit Powder Incorporated Masala Cookies stored in Zip lock cover

Criteria	1 st day		8 th day		15 th day	
	Standard	Sample C	Standard	Sample C	Standard	Sample C
Appearance	4.9±0.29	4.9±0.24	4.8±0.25	4.7±0.47	4.8±0.44	4.7±0.43
Color	4.9±0.29	4.8±0.34	4.9±0.20	4.8±0.26	4.9±0.29	4.8±0.32
Texture	4.9±0.24	4.7±0.34	4.8±0.29	4.7±0.37	4.9±0.29	4.8±0.29
Flavour	4.7±0.33	4.6±0.49	4.7±0.35	4.6±0.49	4.6±0.48	4.6±0.49
Taste	4.8±0.21	4.7±0.37	4.9±0.24	4.8±0.23	4.9±0.24	4.8±0.34

Table 6.1

Mean Score obtained by Standard and Jujube Fruit Powder Incorporated Masala Cookies stored in Airtight container

Criteria	1 st day		8 th day		15 th day	
	Standard	Sample C	Standard	Sample C	Standard	Sample C
Appearance	4.9±0.29	4.8±0.24	4.8±0.25	4.7±0.39	4.8±0.44	4.6±0.52
Color	4.9±0.29	4.8±0.39	4.9±0.20	4.7±0.35	4.9±0.29	4.7±0.45
Texture	4.9±0.24	4.8±0.28	4.7±0.29	4.6±0.49	4.8±0.27	4.7±0.39
Flavour	4.7±0.33	4.6±0.45	4.7±0.35	4.6±0.54	4.6±0.48	4.5±0.65
Taste	4.9±0.21	4.7±0.34	4.9±0.24	4.8±0.31	4.9±0.24	4.8±0.24

From the above table 4, 5 and 6, it was clear that the quality and acceptability of the selected best products of rusk, crackers and masala cookies kept in zip lock cover and airtight container was accepted by the panel members till 15th day.

5.5. Microbial analysis of the standard and selected best products of Jujube fruit powder incorporated rusk, crackers and masala cookies during storage study:

Microbial testing on food products includes presence/ absence of pathogens, total coliform counts and aerobic plate counts. It was observed from the Table 7 that, there was no visible contamination and no microbial growth in both standard and selected jujube fruit powder incorporated products and are free from bacterial load till 15th day of storage. So, from the result we can conclude that the newly formulated product is safe for consumption if it is stored properly.

Table 7
Microbial Analysis of Standard and Selected Products

Name of the Product	Food Group	Indicator Test Result (CFU / gram) and Interpretation/ Standard Plate Count			
		G	M/S	US	PH
Jujube fruit powder incorporated in Rusk, Crackers and Masala cookies	Day 1	-	-	-	-
	Day 8	-	-	-	-
	Day 15	-	-	-	-
	Remark	Standard and Jujube fruit powder incorporated samples was free from bacterial load.			
Organism identified	No Bacterial growth was observed till 15 th day of storage				

Good= G; Satisfactory = S; Marginal = M; Unsatisfactory = US; Potentially Hazardous = PH

5.6. Cost calculation of the standard and selected jujube fruit powder incorporated products:

The cost analysis revealed that the cost of jujube fruit powder incorporated products has no big difference with the standard products. Table 8 depicts the cost calculation of the standard and selected products.

Table 8
Cost calculation of the standard and selected products

Comparison of price for standard and selected proportion of jujube fruit incorporated Products					
Rusk		Crackers		Masala Cookies	
Standard	Sample D	Standard	Sample A	Standard	Sample C
Rs.61.7	Rs.67.26	Rs.4.2	Rs.4.39	Rs.18.1	Rs.18.67

5.7. Popularisation of Selected Product:

Popularization study was conducted among adults. It was done for 30 subjects using a questionnaire method. The subjects were asked to fill the questions before and after giving nutrition education. It consists of 15 questions which were given to the subjects. The popularization study shows that there is a significant difference in the response of people before and after popularizing the selected products. Thus it was concluded that the popularisation of Jujube fruit powder incorporated products had good impact on the subjects. This helps to know the importance of popularizing a product.

5.8. ANOVA for Sensory Analysis of Standard and Selected best products:

The data collected were analysed statistically using Mean and Standard Deviation. Analysis of Variance was done for the standard and selected products. Table 9 depicts the analysis of variance for standard and selected products.

Table 9
Analysis of variance for standard and selected products

Rusk	Source of Variation	SS	Df	MS	F	P-value	F crit
		Between Groups	4.643784	4	1.160946	0.342904	0.845756
	Within Groups	2.26244	20	0.113122			
	Total	6.906224	24				
Crackers	Source of Variation	SS	Df	MS	F	P-value	F crit
	Between Groups	4.643784	4	1.160946	10.26278	0.00011	2.866081

	Within Groups	2.26244	20	0.113122			
	Total	6.906224	24				
Masala Cookies	Source of Variation	SS	Df	MS	F	P-value	F crit
	Between Groups	4.474776	4	1.118694	13.26976	0.0000195	2.866081
	Within Groups	1.68608	20	0.084304			
	Total	6.160856	24				

The above table 9 depicts that, ANOVA comparing the standard rusk and jujube fruit powder incorporated rusk on sensory analysis shows that there is statistically significant difference with and without incorporation. The test statistics F value of standard and sample rusk was 0.342904 and the P value was 0.845756. ANOVA comparing the standard crackers and jujube fruit powder incorporated crackers on sensory analysis shows that there is statistically significant difference with and without incorporation. The test statistics F value of standard and sample crackers was 10.26278 and the P value was 0.00011. The test statistics F value of standard and sample masala cookies was 13.26976 and the P value was 0.0000195.

6. CONCLUSION:

It was concluded that the jujube fruit powder incorporated rusk, crackers and masala cookies was accepted in organoleptic studies. The selected products were high in protein and fibre when compared to the standard products. The selected products were acceptable till 15th day without any microbial deterioration and it is stored in zip lock cover and air tight container hygienically. The cost of the selected best product had no big differences when compared to the standard products.

7. RECOMMENDATIONS FOR FURTHER STUDY:

- Further studies can be carried out by incorporating different fruit powders in other food products.
- Supplementation of jujube fruit powder incorporated study can be carried out for subjects.

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