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Valorization of Date Seed Powder for Development of Enriched Chocolate: A Sensory Evaluation Study

(Waste to Value Innovation)

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Abstract: This study was aimed to convert date seed powder into value added ingredient by incorporating into chocolate. Date seeds are an underutilized by-product of the date processing unit.Date seeds are a major waste product that can be utilized as a valuable and nutritional material in the food industry. Hence in the present study, chocolate was prepared by using varying concentrations of date seed powder by double boiling. Further Sensory evaluation was carried out by using hedonic scale with selected panelist to assess colour, aroma, texture, taste and overall acceptability. Among all samples, sample (B) received the overall liking score due to its balanced flavour, smooth mouth feel and appealing colour. Higher levels of date seed powder reduced acceptability due to increased bitterness and changes in texture. The optimised formulation(B)showed highest quality compared to the controlled sample without date seed powder. This approach not only reduces environmental waste but also promotes sustainable foods Innovation by converting an underutilized by products into a nutritional beneficial product. Overall, the study emphasizes the potential of waste valorization in creating new, marketable, and health promoting food products.

Key words
Date seeds, sensory evaluation, dehydration, chocolate

I. INTRODUCTION

The date palm is widely recognized for its exceptional drought resistance. Date palm has been socioeconomic important in the country. The parched and semi parched regions of countries in north Africa and middle east are beneficial practices for the date palm plant [1]. In India, date palm cultivation is primarily focused in western parts, production of date palm is specifically seen in Kutchh district of Gujarat with 18,286 hectares and produces 171,522 metric tons of fresh dates according to recent data (FAO)[2]. Date is composed of pericarp which is fleshy and ovoid seed, which is ventrally grooved consisting of small embryo and endosperm (hard). Date seeds constitute 10-15% of date fruit weight [3]. The seed characteristics of date varieties vary according to a variety of environmental conditions (such as, soil fertilization, irrigation, daily temperatures, duration of growing period and other post harvesting treatments) are the factors which can effect on physical properties of the date fruits. As the dates contain dietary fibres as well as small amounts of protein, fat, ash, and polyphenols helpful for good digestive health and gut function, regular consumption of dates may help improve lipid profile lowering harmful cholesterol and possibly improving good cholesterol which can benefit heart health [4].

Date seeds are a major waste product that can be utilized as valuable and nutritional material in the food industry The aim of the present study was to incorporate date seed powder and formulation of new product development and improve chocolate quality in terms of functional and textural value. Barhi Dates (phoenix dactylifera L.) is major ingredient of developed product [5]. Date seeds contain protein, carbohydrates, fibres, minerals including (Ca, Mg, K, Na, Fe, P) and oil 5 to 13% which is rich in tocopherols phytosterols, phenols, vitamins and fatty acids (oleic, linoleic, palmitic, lauric). The development of staple foods enriched with fibre is there by an important contribution to a border supply of food products with beneficial health effects. Regular consumption of fibre is an important factor to prevent several diseases and is associated with a standard balanced diet [6].

Chocolate is best known as comforting confection, but historically it has also been consumed for its alleged healing

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properties. Foods and beverages made from beans from the Theobroma cacao tree, have been consumed by humans since at least as early as 46AD. The medicinal usage of cocoa or chocolate either as a primary remedy or as a vehicle to deliver other medicines. In the current scenario consumption of unhealthy food as become wide spread, leading to obesity, high cholesterol and various health risks [7]. Many commercially available foods are unsafe and nutritionally inadequate, lacking essential carbohydrates, proteins, fats, minerals, vitamins. To address this concern and develop a nutrient-dense product, a fibre and antioxidant rich date seed chocolate has been formulated. Chocolate is a universally preferred and comforting food across all age groups, from children to the elderly, which makes it an ideal medium for nutritional enhancement. The product was developed by incorporation date seed powder into cocoa powder, along with date syrup as a natural sweetener and butter to achieve approved structural uniformity and desirable texture. So far, no research on products have focused on making chocolate using date seed powder [8]. Even though many food items like coffee, cookies, chocolate spreads, and biscuits have been made using date fruit, date seed powder has not been used for chocolate preparation until now. Therefore, this work is novel as it is the first to develop chocolate with date seed powder, making it new and innovative in the field.

II.MATERIALS AND METHODS

A.Raw material

The cocoa powder, date palm fruits and butter were purchased from local market, at Hyderabad, Telangana. This study was carried out at Food Technology & Management lab, Loyola Academy Degree and PG college, Hyderabad.

B. Production of date seed powder

The date palm fruits were washed and sorted carefully to remove damaged ones. Date seeds were separated from date fruit by manual method. Seeds were dried using tray drying method were used to remove stickiness of date seeds and moisture content.

Figure 1 Tray drying

C.Tray drying &Roasting

A tray drier is a commonly used drying equipment in the food, pharmaceutical, and chemical industries to remove moisture from solid materials by using controlled heat and airflow, allowing products to become shelf-stable and safe. In this study, Date seeds were dried at 60℃ for 48 hours and dehydration kinetics were calculated [9]. Seeds were removed from the tray dryer and allowed for roasting at 150℃ for 30 minutes and grinded into coarse particles size and further blended into fine particles. It was then sieved by using mersilene cloth and stored in air tight container for further analysis**.**

Figure 2:Roasting of date seeds

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Figure 3: Date seed powder

D. Production of date syrup

The separated date pulp was washed and boiled at 100℃, and the content was extracted using mersilene cloth. Then the obtained content was concentrated at 100℃ for 20minutes until the water evaporated from the liquid to obtain a thick syrup, then the final product was cooled and filled in air tight glass jar, stored at dark place.

Figure 4: Preparation of date syrup

Figure 5: Filling of date syrup

E. Formulation of samples

Different samples were prepared using cocoa powder, butter and date syrup. Date seed powder with different concentrations were incorporated to the samples. Table 1 shows the formulation of samples.

Table 1: Formulation of Samples

Quantity of Ingredients	Sample A	Sample B	Sample C	Sample D
Cocoa powder	100gm	100gm	100gm	100gm
Date seed powder	-----	13g	15g	17g
Date syrup	40g	40g	40g	40g
butter	35g	35g	35g	35g

F. Production of date seed chocolate

In the present work, butter was melted through double boiling, to which cocoa powder was added and mixed thoroughly, further to the mixture date syrup was added slowly to avoid lumps formation. Then all the ingredients were removed and immediately date seed powder was added to selected formulation and mixed thoroughly until smooth consistency was obtained. The mixture was cooled and filled into chocolate mould. Further the moulds were freezed at -20℃. The same procedure was carried out for all formulations A(control), B, C and D.

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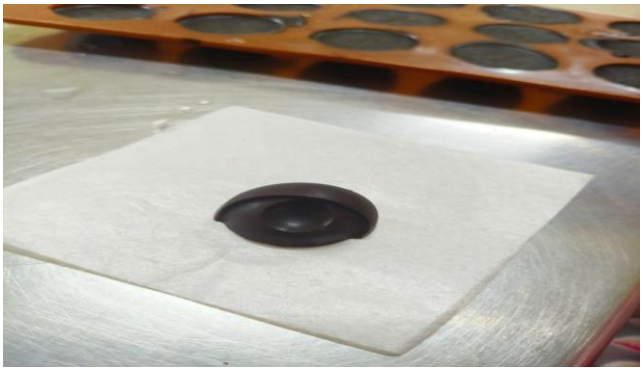

Figure 6:Date seed powder chocolate

Collection of Dates

↓

Separation of seeds

↓

Seed drying (Tray drying 60°C)

↓

Roasting of seeds (temperature 150°C)

↓

Grinding of roasted Seeds

↓

Blending

↓

Sieving (to attain fine powder)

↓

Double Boiling:

Addition of Butter, Cocoa powder

Mixing

↓

Addition of Date syrup

↓

Cooling and mixing

↓

Addition of Date seed powder

↓

Filling into mould

↓

Freezing (-20°C)

↓

Final Date Seed Chocolate

Figure 7: Process flow chart of date seed powder chocolate

G.Sensory analysis of date seed[chocolate

Sensory evaluation was preformed using 9 point hedonic scale with 30 panelist. The formulated samples along with control sample was analysed for following parameters such as colour, flavour, texture, overall acceptability and were rated according to the method described [10&11] was used to analyse the result.

9 Point Hedonic Scale Performa

Name:

Date:

Sample:

Taste these samples (sample 1,2,3….) and their controls respectively and check

how much you like or dislike each one. The appropriate scale to show your

attitude by checking at the point that best describes your feeling about the

samples following attributes:

- Overall acceptability

Please give a reason for these attitudes

Remember you are the only one who can feel what you like. An honest

Expression of your personal feelings will help us.

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Table 2: 9 Point Hedonic Scale Performa

Sample	**Overall acceptability**
Like extremely 9	
Like very much 8	
Like moderately 7	
Like slightly 6	
Neither like or dislike 5	
Dislike slightly 4	
Dislike moderately 3	
Dislike very much 2	
Dislike extremely 1	

III. RESULTS AND DISCUSSION

H. Dehydration of date seeds:

Tray drying method was used for dehydration of date seeds.The results were recorded at the time interval of every one hour upto 7 hours. Shown in table 3.

Table 3 Results of Tray drying

Time Interval	Weight of the sample
1 hour	184.997gm
2hours	184.995gm
3 hours	183.772gm
4 hours	183.1076gm
5 hours	182.543gm
6 hours	180.879gm
7 hours	180.098gm

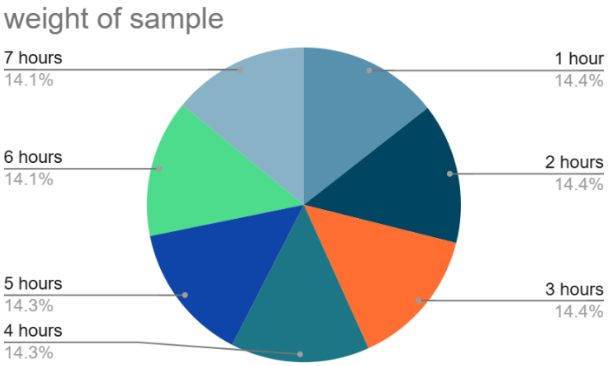

Figure 8: Dehydration kinetics for date seeds using tray drying

From the above graph (figure 8), the weight of date seeds decreased from 184.997g to 180.098g indicating the loss of moisture content. This study has shown significant reduction of moisture content 3.33%to 1.03% as shown (figure8). Previously The result obtained showed decrease of moisture content from 2.33%0.33% [12]. Hence the present results were similar to the previous studies.

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Table 4: Score card of sensory evaluation results

Attributes	Sample A	Sample B	Sample C	Sample D
Appearance	8	9	8	8
Color	8	9	8	7
Texture	8	9	7	7
Aroma	8	8	8	6
Taste	7	8	7	5
Overall liking	7	8.5	7.5	6

I . Roasting

Further seeds are then roasted to dark brown colour at 150°C, this process removed excess moisture content and enhanced flavour and aroma of seeds. After grinding and sieving, a fine and smooth powder was obtained with uniform particle size, free from lumps and coarse fragments. The powder exhibited a mild coffee-like flavour and a light nutty taste, making it suitable for use in functional foods, bakery products, and beverages. This results also suggested that the drying temperature place a key role determining the final quality attribute of the product. Higher temperatures accelerated moisture removal but causes slide changes in colour and texture, whereas moderate temperature balanced drying with minimal quality loss.

J. Date syrup

The preparation of date syrup yielded a thick, dark brown liquid with a pleasant caramel like aroma, after boiling, filtering, and concentrating the pulp, the syrup developed a smooth and glossy texture with uniform consistency. The natural sweetness increased during concentration without the need of added sugar. The final product was stored in air tight glass jars, showed no crystallization or separation[13].

K. Date seed powder chocolate

The date seed powder chocolates showed good texture, smooth consistency, and uniform mixing without any graininess. Addition of date seed powder improved the colour, giving a slightly darker and roasted appearance. The chocolates developed a mild nutty flavour and were well accepted in terms of taste and aroma. The fibre and antioxidant content of date seed powder contributed to a firmer structure after freezing and enhanced the nutritional value. Overall, date seed powder improved the sensory attribute of chocolates without affecting their stability.

L. Sensory analysis

Sensory evaluation was conducted on different formulations of date seed chocolate, labelled with reference codes A, B, C and D. A multiple comparison test was used to assess the differences among the samples. A total of 30 untrained panelists were participated in the evaluation, and each panelist received all coded samples. They were instructed to compare the coded samples based on sensory attributes. Scores were assigned according to the predetermined sensory scale.

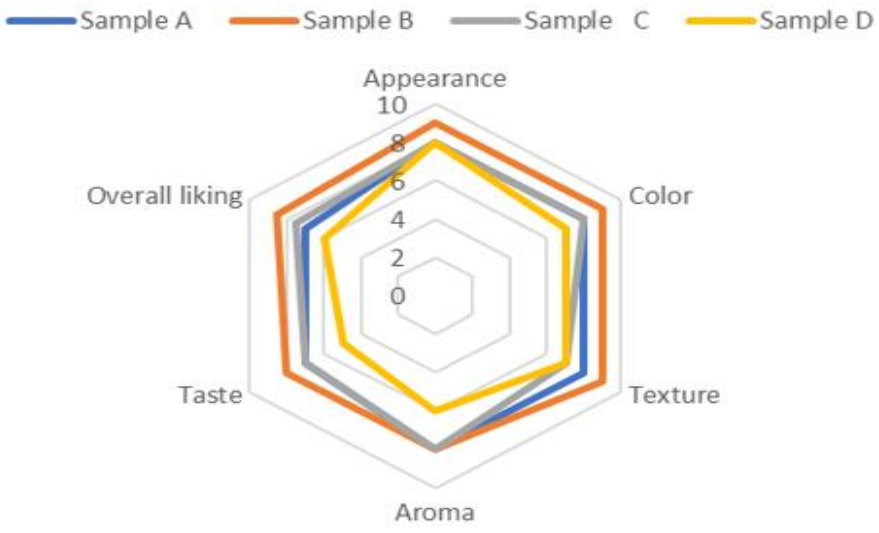

Figure 9: Sensory analysis chart

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Sample A was considered as control, as it did not contain date seed powder. Samples B, C and D were developed by incorporating increasing levels of date seed powder (13 %, 15%and 17% respectively), with constant quantities of cocoa powder, date syrup and butter as mentioned in table 1.The use of natural sweetener is the substitution of sugar in the present date seed powder chocolate, the role of sugars in food ; substitution of sugars with alternative sweeteners ;product development, marketing and labeling; target customers were sugar reduced products and outlook for products made with alternative sweeteners[14].

The results of sensory analysis (table4 and figure 9) in the present study revealed a clear variation in formulated samples evaluated by panelist. Although Sample A showed good acceptability (7) due to familiar flavour and texture, Sample B recorded the highest overall liking score (8.5). Panelists particularly appreciated its balanced appearance, colour, aroma, taste and texture. Samples C and D received comparatively lower scores(7.5 and 6). The results indicated that levels of date seed powder affected the flavour and mouthfeel of developed product. The sensory scores demonstrated that the addition of date seed powder at 13 % (Sample B) not only enhanced colour and aroma but also improved the taste profile without compromising texture[15,16,&17]. Therefore, Sample B was selected as the optimized formulation for further characterization and analysis.

The sensory evaluation revealed noticeable difference among the 4 formulated samples in terms of colour, texture, aroma, taste, appearance and overall acceptability. From 4 samples mentioned in table 4, sample B achieved highest rating of appearance (9), colour (9), texture (9), and taste (8), which suggest that its ingredient composition provide a visually appealing product with a desirable mouthfeel and flavour profile. This balanced sensory performance is reflected in its overall liking score of 8.5, the highest among all samples.

Sample A (control) which scored (8.5) in appearance, colour, texture, aroma, performed well but obtained lower scores for taste (7), and overall liking (7). This indicates that although sample A exhibited accepted physical attributes, its flavour was not as appealing to the panelists compare to sample B. sample C showed moderate acceptance among the panelists. Although its appearance and color was rated similarly to the other samples, a slight decline in texture and taste both scoring (7) influenced the overall perception of the product the same reductions in mouthfeel and flavour were reflected in its overall liking score of (7.5), while sample C was acceptable, it did not stand out as strongly as the most preferred sample. Meanwhile, sample D received the lowest score in almost all categories, particularly for aroma (6) and taste (5), which strongly contributed to its lower overall acceptability rating of 6 , thus result indicated that the formulation used for sample D was less preferred by the panelists due to palatability and aromatic limitations,

Overall, it was clear that taste and texture influence the panelists choices the most. Samples that scored higher in this two areas were naturally liked more. Sample B stood out because it offered a good balance of flavoured and mouthfeel without affecting its apperance and aroma. The findings show that developed product Sample B meets consumer expectations in terms of flavour, aroma, texture and overall acceptability.

IV. CONCLUSION

Date seeds are byproduct of dates, which are usually discarded as waste during processing of dates. They can be effectively used for various application in food industry, the present work mainly focused on usage of date seed powder for preparation and development of chocolates. Hence the optimised formulation (Sample B) showed improved the that has enhanced the taste, colour, texture, aroma and appearance compared to control and other formulations. Thereby increasing the overall acceptability of the developed product by sensory analysis. The developed date seed powder chocolate showed good sensory acceptability demonstrating that waste materials can be incorporated into food products without compromising quality or consumer preference. This approach not only reduces environmental waste but also promotes sustainable foods innovation by converting an underutilized by products into a nutritional beneficial product. Overall, the study emphasizes the potential of waste valorization in creating new, marketable, and health promoting food products.

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