

Formulation and Sensory Acceptability of Cauliflower Leaf Jellies

Balaji S¹ and Dr. M. Thamarai Selvi²

Student, Department of Food Processing Technology¹

Assistant Professor, Department of Food Processing Technology²

PSG College of Arts and Science, Coimbatore, India

Abstract: Consumption of green leafy vegetables is part of maintaining a healthy lifestyle. Cauliflower leaves are rich in iron and calcium also has highest waste index. In order to diversify jellies and promote healthy eating, an attempt was made to utilize its leaves thus reducing the wastage. This study investigated the formulation and acceptability of jelly which were formulated with different proportions of orange juice and cauliflower leaf extract in the ratio of 100:0, 75:25, 50:50, 25:75, 0:100. Present study includes standardization of jellies, organoleptic evaluation, nutrient and cost calculation of formulated cauliflower leaf jellies. Among the five variations, jellies containing 50 percent cauliflower leaf extract had higher sensory score (8.8 ± 0.2) than the plain orange jelly. On supplementation of cauliflower leaves (Variation II), iron and calcium content increased from 0.4 to 10.8 mg and 9 to 192.3 mg respectively. The cost of the formulated jelly was found to be Rs 2.0/15g. Formulated jellies also had better micronutrient content when compared to standard jellies. It can be concluded that cauliflower leaf jelly can be prepared with good sensory, nutritional quality and cost-effective product as a means of nutrient enrichment. Hence, cauliflower leaves could be utilized to progress the nutritional status of the people.

Keywords: Cauliflower leaf; Value added jelly; Sensory acceptability; Iron; Calcium.

I. INTRODUCTION

Sugar confectionery is one of the favorite foods among people from a wide range of age. It was discovered that 20–25% of youngsters and 6-13% of adults consistently consume confectionary goods. (Dorn et al. 2015). Confectionery products are food formulations characterized by aqueous dispersions of sugar syrup and are available in a various variety of forms including jellies, caramels, marshmallows, gums, gummies, and hard candies. Jelly is characterized by a soft texture typically conferred by an agar or gelatin or pectin-based gel (Fisher, 2011). This is one of the oldest process of preserving fruits for consumption in the off-season and more value added and fruit flavoured jellies are produced these days (Arjun Ringwal. 2019). Utomo et al. (2014) stated that jellies made with different gelling agents offer certain/specific texture characteristics and other sensory properties. Confectionery products can be considered as a convenient carrier of vital nutrients which lack in preschool and school going children.

Human nutritional research works are continually evidencing that a well-balanced diet, rich in fruit and vegetables, promotes good health and may reduce the risk of certain diseases in the body (Catunescu et al. 2012). Green leafy vegetables are rich source of fibre and micronutrients. Multiple micronutrient deficiencies are more common than single deficiency mainly in developing countries like India (Rakhakumar et al. 2017). Nutritional problems are more severe and mostly people in the developed countries also suffer from different forms of nutritional deficiency. Nutritionists are now trying to encourage people for supplementation of green leafy vegetables in nutritional recipes to fight with these micronutrient deficiencies and the major micronutrient deficiency in India is iron deficiency anaemia. Green leafy vegetables are good source of iron. India ranks second in the world in the production of vegetable and third in production of fruit. There are many different varieties of green leafy vegetables, which are rich in micronutrients but they are discarded or not used properly for human consumption. Cauliflower leaf (*Brassica oleracea* var. botrytis) are good in nutrients and are rich source of iron, calcium, and beta carotene which can be used in value added items



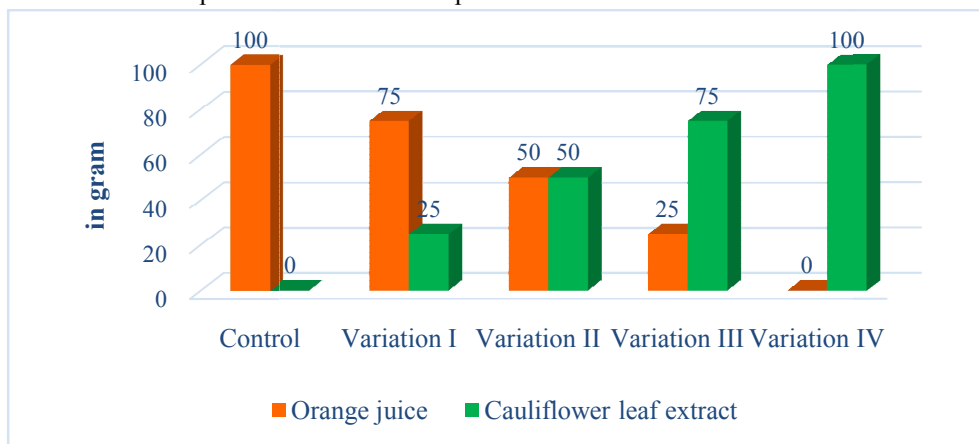
(Kowsalya and Sangheetha, 1999). Cauliflower leaves falls under the category of underutilized products which are often neglected. In its case, inflorescences of the cauliflower are always used for human consumption and leaves are discarded and are used as animal feed. (Ambika chauhan and Intelli, 2014)

Among all the green leafy vegetables, Cauliflower greens (Brassica olercealvar botrytis) was found to have the maximum amount of iron such as 40mg/100g. The mean hemoglobin level of the selected 20 subjects had increased from 12 to 12.5 g / dl after supplementation of 50g cauliflower greens poriyal for 90 days was statistically significant at five percent level. These results indicate more beneficial effect of cauliflower greens (Kaviyarasi et al. 2017). Sulforaphane in cauliflower and other cruciferous vegetables has been found to fundamentally regulate pulse rate and kidney capacities. Cauliflower leaf contain sarcoma prevention agents and other bioactive compounds which has been emphatically connected with cardiovascular illnesses and constant sicknesses (Cohen et al. 2000; Knekt et al. 2002 and Zhang and Hamauza, 2004).

The cauliflower leaf jelly could have a better market value as it is vegan food product. It is also one of the ways to improve the nutrient supply especially to the younger population. Cauliflower leaf jelly is also the cost-effective way of the nutrient supplement and value addition which make this raw material more reliable and affordable. Recent consumer preference has shifted toward purchasing food products with a wide spectrum of health benefits. This research aims to assess the effect of substituting cauliflower leaf extract in jellies and its impact on the sensory acceptability and micronutrient content of formulated jelly.

II. MATERIAL AND METHODS

AnCauliflower leaves are collected from Uyir organics which is a TamilNadu organic certified and USDA certified organic store since normally grown cauliflower leaves tend to contain pesticidal residues. All other raw materials used in these experiments have been purchased from local supermarkets.



Graph 1: Ratio Between Orange Juice and Cauliflower leaf extract

The extract prepared by separated leaf from cauliflower stalk by hands with the help of knives. The leaf was soaked for 20 minutes, then washed and drained. The fresh leaf is blanched in the hot water at 85° C for 10 to 15 second and then dipped in cold water to stop further heating. The cauliflower are then grinded and made into a paste and mixed in the ratio of cauliflower leaf: water-1:1.8 and this extract is cooked for 5mins to remove the raw flavour of leaves and it is used for the proportionate formulation of jellies included 100g of orange juice (control sample) and other 3 variations were replaced with 25%, 50%, 75% and 100% cauliflower leaf extract respectively. 85 g of sugar, 2 g Plain China Grass (Agar) along with 0.5g of Cardamom are used.

All the ingredients are weighed and required amount of the strained orange juice & cauliflower leaf extract was taken in a bowl and mixed well. The mixture was heated at 100°C with continuous stirring. Soaked plain china grass was added and heated with continuous stirring. Weighed amount of sugar was added to the pan. Continuously stirred for 3.5 minutes, until total soluble solids reached to 65° Brix by following the FSSAI specifications. Prepared jelly mixture was filled in moulds and cooled at the refrigeration temperature. Jellies are demolded and stored at a airtight container.

Scientific methods of organoleptic evaluation of formulated products were analyzed using 9- point hedonic scale. Formulated cauliflower leaf jellies were evaluated by 30 semi-trained members based on the variable such as colour and appearance, texture, flavour, taste and overall acceptability. Where 9 represent like extremely and 1 represents dislike extremely. The scores were analyzed statistically to obtain the highly acceptable product (Ratchanee Charoen et al. 2015). The nutritional quality of developed products was calculated by taking in consideration the chemical composition of the selected waste leaves of vegetables and value given in the Food Composition Tables compiled by Gopalan et al. 2011. The cost of the product was also calculated using the cost of raw materials, packaging materials, overhead charges and profit percentage to obtain the selling cost.

III. RESULT

3.1 Mean Sensory Score for Control and Formulated Jellies

Sensory evaluation of the formulated jellies is done with thirty semi trained panel members. The mean scores for colour, texture, taste, flavour and overall acceptability of different samples are presented in table-1. The colour of the jellies changed from creamy to dark green as substitution level increases. Score for colour and appearance was equal for Variation II and control (8.8 ± 0.2) whereas it gradually decreased as the substitution increases as variation III (7.7 ± 0.3) and Variation IV (6.0 ± 1.1). Texture of the jelly plays an important quality parameter for the jelly, which affect the acceptability at a higher rate after taste and the texture of all jellies, was found excellent and set well it had soft and smooth cutting texture. The formulated jellies along with the cauliflower leaf tasted good. The taste and flavour of the cauliflower leaf does not interfere more with the taste of the final product but above 50 percent incorporation the taste of the product showed strong aftertaste of cauliflower leaf which is not highly acceptable. Variation II with 50 percent cauliflower extract had a good score (8.8 ± 0.2) with effective substitution and 100 percent cauliflower leaf extract jellies had the least mean value for the overall acceptability (6 ± 1.1). Results showed the addition of more the cauliflower leaf extract could result in decreases in all the sensory attributes. At 50%, jellies had good scores for all the sensory attributes evaluated. Above this level, jellies received lower sensory scores.

Table I: Mean sensory score of the formulated jellies

Criteria	Control (C)	Variation I (V ₁)	Variation II (V ₂)	Variation III (V ₃)	Variation IV (V ₄)
Colour and appearance	8.8 ± 0.2	8.6 ± 0.6	8.8 ± 0.2	8.1 ± 0.8	6.9 ± 1.7
Texture	8.4 ± 0.6	8.0 ± 0.7	8.7 ± 0.3	7.5 ± 0.1	6.3 ± 1.3
Taste	8.6 ± 0.4	8.1 ± 0.7	8.6 ± 0.3	7.6 ± 0.5	6.0 ± 1.4
Flavour	8.6 ± 0.6	8.1 ± 0.8	8.7 ± 0.3	7.8 ± 0.9	5.9 ± 1.3
Overall acceptable	8.5 ± 0.5	8.0 ± 0.5	8.8 ± 0.2	7.7 ± 0.3	6.0 ± 1.1

Table III: Anova

Source of variation	Sum of Squares	Df	Mean Square	F	p-value	F crit
Control and formulated variations	0.7976	4	0.1994	7.083	0.001759	3.006917

From the above data it can be interpreted that there is significant difference ($p < 0.05$) between the variables, colour and appearance, taste, texture, flavour hence null hypothesis is rejected and alternate hypothesis is accepted.

3.2 Nutrient Calculation of the Formulated Cauliflower Jellies

Nutritive values are calculated using Nutritive value of Indian food (ICMR) published by National Institute of Nutrition.

Table IIIII: Nutrient calculation of control and formulated variations per 100g

Nutrients	Control	Variation I	Variation II	Variation III	Variation IV
Energy (Kcal)	160.9	168.4	176.1	183.7	191.3
Carbohydrate (g)	46.5	47.3	48	48.8	49.6
Protein (g)	0.2	1.02	1.7	2.5	3.3
Fat (g)	0.1	0.2	0.3	0.5	0.7
Iron (mg)	0.4	5.6	10.8	16.1	21.3
Calcium (mg)	9	118.46	192.3	266.2	340.2

On interpreting the calculated nutrients it could be observed that there is a slight increase in all the major nutrients like Energy, Carbohydrate, protein and fat. However, there is marked increase in the micronutrients like iron and calcium compared to the control sample. Iron is a mineral that our bodies need for functions like it is part of hemoglobin, a protein which carries oxygen from our lungs throughout our bodies. It helps our muscles store and use oxygen. Iron is also part of many other proteins and enzymes. The skeletal and non skeletal calcium (Ca²⁺) are in equilibrium. The calcium can be drawn upon from bones to make up the deficiency of blood calcium and when the deficit is made up calcium is again re-deposited in bones (Pravina et al., 2013). Blood calcium level is maintained within narrow range with the interplay of vitamin D and several hormones by controlling absorption, excretion and bone turnover (ICMR, 2020). 15g (one serving) of the variation II jelly can satisfy 14.7% iron and 5.2% calcium daily RDA requirement for children 4-6 years which is a good concentration of micronutrient in a lesser quantity. Variation II contains 7.2g/ 15 g of carbohydrates. The protein and fat content of the jellies are determined as 0.3g /15g and 0.04 g/ 10g respectively, these three macronutrients help to provide energy of 30 Kcal/10g.

3.3 Cost Calculation

The cost of the product was also calculated using the cost of raw materials, packaging materials, overhead charges and profit percentage to obtain the selling cost. The selling cost of the control jellies was calculated to be Rs.4.0/15g which has higher than the cauliflower leaf jellies with 50 percent substitution that was Rs 2.0/15 g. Commercial jellies like Mahak fruit jelly belly cup is Rs.2.8/15g which is higher than the formulated jelly. The cost was also affordable to the categories of people. Commercially available jellies in market contain ingredients such as artificial colour, preservatives and flavouring agents. The formulated cauliflower leaf jellies do not have any artificial flavours or colours. These cauliflower leaf jellies are also considered superior in terms of micronutrient content when compared to prepared control and commercially available jellies in the market.

IV. DISCUSSION

Among the formulated cauliflower leaf incorporated jelly – Variation II was highly acceptable because of its good sensory score (8.8±0.2) and also have appreciable amount of micronutrient content when comparing with control. From ANOVA test, it was found that there is significant difference in the sensory score between the formulated variations and sensory characteristics. Jaydeep Singh and Suresh Chandra, 2012 concluded that mixedfruit jelly prepared with guava extract and carrot juice with the ratio of 75:25 was found to be better organoleptically than those ratios and followed by the ratio of 50:50 and 25:75, respectively. However, in the present investigation, 50:50 orange and cauliflower leaf extract were highly acceptable. Akshara et al (2020) revealed that the sensory score of developed amla-betel leaf extract 8.5 which was similar to the present study. Sagarika Chakraborty et al (2015) suggested that roasted

dry CLP can be used as vegetable calcium supplement which can easily be incorporated into the many recipes commonly used in the day-to-day menu of the people. Regular consumption of cauliflower leaf powder may be helpful for preventing and reducing the prevalence of calcium deficiency disorders.

The nutrient content found to be increased on increasing the cauliflower leaf extract concentration however the sensory score decreases hence the highly acceptable Variation II (50 percent) was selected. The iron content in the variation II is almost 25 times greater than the control. The increase in the iron value on the incorporation of the cauliflower leaves in pancake, dhokla and idly was also reported by Ambika Chauhan and intelli (2014). Cauliflower leaf powders incorporated at 10 per cent level in masala biscuits, masala buns, gingelly chikki, wheat soy halwa, had mean acceptability scores of 3.4, 3.6, 3.4 and 3.9 respectively on a five-point scale. Products were found to be rich in iron, beta carotene and calcium (Begum et al., 2000).

V. CONCLUSION

The development of value added jellies with cauliflower leaf can be an alternative for commercial jellies in the market and it is a high-quality candy product that meet consumer demands in terms of sensory and micronutrient content. The formulated jelly had its natural colour from cauliflower leaf (chlorophyll) and orange (carotene). Jellies possess a natural pleasant colour and were attractive to the consumers. The formulated jelly is high in iron (10.8mg of iron/100g of jelly) and calcium (192.3mg of iron/100g of jelly). This study shows that acceptable and nutritious jellies could be obtained from cauliflower leaf since these formulated jellies competed favorably with 100 percent orange jellies (Control). The study confirms that cauliflower leaf can be utilized for making highly acceptable jellies with 50 percent cauliflower leaf extract which shows underutilized products can be converted into a value-added product in less cost. Jellies which are available in the market now are mainly loaded with artificial flavours, colours and preservatives and are deficient in micronutrients. The cost of value-added jellies was Rs. 2.00 per 15g of jelly which is less than the control and commercial products. The confectionery industry in India is growing at a very fast rate and the demand for health confectionery products is increasing. The confectionery and other branch of food industry can exploit cauliflower leaf as a natural and inexpensive source of nutrients to produce nutritionally superior food products.

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BIOGRAPHY



Myself Balaji.S, Completed B.Voc Food Processing technology at PSG College of Arts and science. I am interested in reduction of waste products in the food processing and convert it to a value added food products. I also have keen interest in new product development. For contact: balaji252000@gmail.com, <https://www.linkedin.com/in/balajipsgfoodtechnology>