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Development and Physico Chemical Evaluation of Dehydrated Strawberry and Orange Ice Popsicles.

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Abstract

Ice popsicles are popular frozen treats enjoyed by people of all ages, offering a refreshing experience during hot summer days. This study aimed to develop and assess the quality of dehydrated strawberry and orange ice popsicles. The formulation process involved the incorporation of dehydrated strawberry powder and orange powder into a base mixture comprising water, sugar, and lemon. Different formulations were tested to optimize taste, texture, and appearance. Quality evaluation was conducted through sensory analysis, assessing attributes such as flavour, texture, colour, and overall acceptability. Additionally, physical characteristics such as melting rate and hardness were measured. Consumer demand for frozen desserts has surged in recent years, driven by a growing appetite for refreshing, flavourful treats. Among these, ice popsicles remain a perennial favourite, offering a delightful combination of taste and convenience. In response to evolving consumer preferences and the increasing emphasis on natural ingredients. Formulation and quality assessment of dehydrated strawberry and orange ice popsicles by conducting T1, T2, T3 trails. The trail T2 is well satisfied all the conditions of developed ice popsicles.

Keywords: *Ice popsicles, De hydrated strawberry, Orange, Sensory analysis, Melting point.*

INTRODUCTION:

Strawberries are vibrant red, heart-shaped fruits known for their juicy texture and sweet, slightly tangy flavour. Originating from Europe in the 18th century, strawberries are now cultivated worldwide and enjoyed in various culinary dishes, from desserts to salads. Nutritionally, strawberries are a powerhouse, low in calories yet rich in essential nutrients. Strawberries approximately 150 grams provides about 50 calories, making them an excellent choice for weight management. They are packed with vitamin C, offering more than 100% of the daily recommended intake per cup, which supports immune health and skin vitality. Additionally, strawberries are a good source of dietary Fiber, aiding digestion and promoting satiety. They also contain antioxidants such as anthocyanins, which have been linked to reduced inflammation and a lower risk of chronic diseases like heart disease and certain cancers. With their delightful taste and impressive nutritional profile, strawberries make a delicious and healthful addition to any diet.

Oranges, citrus fruits native to South east Asia, have become a global dietary staple due to their refreshing taste and versatility. They are not only delicious but also packed with essential nutrients. Oranges are an excellent source of vitamin C, which supports immune function and skin health. Additionally, they provide dietary fiber, and contain significant amounts of vitamin A, folate, and potassium. These nutrients collectively contribute to cardiovascular health, vision, and overall bodily functions. Low in calories and high in antioxidants, oranges are a nutritious choice for a balanced diet.

An ice pop is a frozen water dessert on a stick that is colored and flavoured. It is made by freezing colored flavored water around a stick. Fruit juice can also used, either by itself or in a mixture with water and other ingredients. Once solid, the stick is then used as a bundle to hold the ice pop (Agrawalet.,al 2011).It is usually rectangular or cylindrical shape with a stick that runs vertically with a free extension of the solidified block at one of its ends. Popsicles prepared with fruit based ingredients are considered nutritious due to the vitamin and mineral contents (da Silva et al., 2020). In general, Popsicles and the conventional ice creams are marketed in various forms such as conventional ones, light, fat-free, and low sugar content (Granato et al., 2018). Popsicle is generally made up of artificially colour, flavouring agents, preservatives and white sugar with nonnutritive value. Popsicles are globally appreciated as refreshing foods by both adults and kids, especially in tropical countries with many beaches and ancient culture. It is also easy to make and low cost (Balthazar et al., 2017).Therefore, it can be used as an ideal medium to deliver micronutrients and immune nutrients. Immunity refers to the body's ability to prevent the invasion of pathogens.

Immune boosting foods strengthen the body against infections. In general, the fruit and fruit extracts are rich in vitamins, minerals and also possess strong antioxidant and anti-inflammatory properties. Therefore, this study aims to formulate ice popsicle with dehydrated strawberry and orange along with the addition of immune boosters (lime) and brown sugar without addition of artificial colour and flavouring agent the icepopsicle was 37.8% ($P<.01$) more effective than water regarding the intensity variation between the initial and final thirst. The thirst intensity and number of interventions were different for the two groups as from these condmoment ($P<.01$). Regarding not reaching after an hour of evaluation and intervention, the relative risk was 41%, the relative risk reduction was 59%, the absolute risk

reduction was 31%, and the number needed to treat was 3.2.(Marilia Ferrai Conchon, etal.,2018).

Materials and Methods:

Materials:

Fresh strawberries and oranges, brown sugar, water, ice pop Molds, lemon, Beetroot juice, dehydrator or oven, blender or food processor, strainers, and packaging materials.

Methods:

Dehydration of Strawberry: Typically, strawberries are dehydrated at temperatures between 145°F to149°F (about 62°C to 65°C) to preserve flavour and colour while removing moisture. Adjust the temperature based on the equipment and desired outcome, but avoid temperatures that might scorch or cook the fruit. It is evident that water removal from fruit is dependent on the drying method. The drying rate for hot air drying was found to be 6.0×10^{-4} kg water/ (kg dry matter s). This value agrees with the maximum drying rate for convective drying of strawberries at 65°C as reported by (Doymazet, et al 2008),

Dehydration of Orange: Orange slices can be dehydrated at low temperatures, ranging from 125°F to145°F (about 52°C to 63°C), to remove moisture effectively without burning. (Xanyar Mohammad et, al 2020)

Procedure: The strawberries and oranges, where they were selected for absence of damage, washed in running water and cleaned with 0.02% sodium hypochlorite (NaClO) for 30 min following recommendations by ANVISA. They were then de-pulped; the seeds & peel were removed in the process, the dehydrated strawberries and orange slices made to a fine powder separately. Mix the powdered ingredients along with sugar syrup according to taste preferences and lemon as preservative. Ensure it's well mixed and smooth without any air sacs in the mixture. Pasteurization of the mixture to kill the harmful bacteria and pathogens ranges between160°F (71°C) to 180°F (82°C) for a few minutes. After pasteurization, the mixture is usually cooled and then packed and frozen. The treatments consisted of three different Popsicle formulations and each treatment consisted of four replications and each Popsicle is considered a replication.

Table 1. Different formulations tested for strawberry and orange ice Popsicle.

S#	SAMPLE	Treatment 1	Treatment 2	Treatment 3
1	Sugar syrup	15ml	20ml	25ml
2	Dehydrated strawberry powder	5gm	10gm	20gm
3	Dehydrated orange powder	5gm	10gm	20gm
4	Lemon juice	2ml	3ml	5ml
5	Beetroot juice	2ml	3ml	5 ml
6	water	70ml	55ml	100ml

The pulp used to formulate the popsicles was characterized with the following analyses: vitamin C content = 403.44 mg ascorbic acid 100 mL-1 pulp, pH = 5.88; Soluble Solids (SS)

= 7.4 ºBrix; Titratable Acidity (TA) = 0.90 citric acid 100 g-1 pulp; SS/TA ratio = 3.9191 and Crude Protein = 2.72%. In addition, the following macro and micro nutrients were identified, whitout statical representativeness: 0.08% phosphorous (P), < 0.02% Sodium (Na); 0.87% potassium (K), 0.32% calcium (Ca), 17.71 mg/Kg iron (Fe), 34.05 mg/Kg zinc (Zn) and 0.47 mg/Kg selenium (Se).

The popsicles were formulated using the ingredients and concentrations as shown in Table 1.

According to each treatment, the formulations were processed and the resulting mixture is placed in popsicle molds and frozen at -12 to -15 °C. After two days freezing, the popsicles were taken to the Laboratory, where the following were assessed:

The pH, was determined by reading on a pH meter.

Soluble solid content, determined by direct reading on a RTD-45 portable refractometer and the results expressed in º Brix.

Titratable acidity content, determined by titrimetry (Instituto Adolfo Lutz; 2008), considering 10 g of each of the formulations, which were diluted in distilled water to 100 mL. For reading, after addition of the phenolphthalein indicator, the solution was titrated with NaOH solution (0.1M), and results expressed in grams of citric acid 100 g-1 sample.

Vitamin C content by the Tillmans titrimetry method (Instituto Adolfo Lutz: 2008). This method is based on the reduction of the 2,6 dichlorophenol indophenol dye (DCFI) by the acid solution of ascorbic acid. 10 g of the sample was diluted in 10 mL of oxalic acid, filtered and titrated with the Tillmans solution. The reaction is fast and the final change is indicated by the dye, which in acidic environment and once oxidized by ascorbic acid changes color to a pink color. The results were expressed in milligrams of ascorbic acid 100 mL-1 sample.

The acceptability index ("Ratio") calculated by the SS/TA ratio.

Samples of each treatment and the pulp, each one containing three replications, were taken for quantification analysis of nutrients & crude protein. The analysis method used to quantify phosphorous was nitro-perchloric digestion and colometry of the ammonium phosphomolybdate (Lott et al.., 1956); for sodium and potassium, flame photometry (Skoog et al., 2002); atomic absorption spectrophotometry (Perkin-Elmer Corp, 1966) was used to analyze calcium, iron, zinc and selenium. The results for characterization only, are shown in Table 2.

Table 2. Nutrients and crude protein Analyses in different formulations tested for strawberry and orange ice popsicle.

Treatment	Crude Protein	P	Na	K	Ca	Fe	Zn	Se
T1	7.0	0.21	0.13	0.46	0.26	41.3	9.26	0.04
T2	6.85	0.19	0.13	0.40	0.25	49.6	9.30	0.02
T3	6.39	0.21	0.12	0.41	0.27	43.0	9.30	0.02

For the sensorial analysis the samples were placed in disposable cups and given with random numbers. Each assessor received five popsicle formulations and a sheet of paper with a questionnaire and a hedonic scale to assess the appearance, color, flavor and texture ranging from nine to one (9 - I liked it very much, 8 - I enjoyed it, 7 I - liked it regularly, 6 - I liked it a little, 5 –indifferent- I didn't like or dislike it, 4 - I disliked a little, 3 - I regularly disliked it to moderately disliked it, 2 – I disliked it, and 1 – I extremely disliked it). Another score was used to assess the purchase intention (1 - definitely would buy, 2 - would probably buy, 3 - perhaps yes/perhaps no, 4 - would probably not buy, 5 definitely would not buy). The assessors drank the water between assessments so there was no confusion between the formulations analyzed.

Results and Discussion:

The results of chemical analysis are shown in Table 3. pH, Moisture & ash contents shown significant difference both in case of treatments as well as storage period. Whereas, Fat and protein shown significant differences in case of treatments while non-significant differences have been obtained in case of storage intervals. Significant decrease in pH and significant increase in acidity is due to presence of ascorbic acid in strawberries and oranges. The results of this study are supported by the findings of Gwiszczynska and Kaluziak (1971). They found that pH decreased in all the samples of Popsicles during storage.

Table 3. Effect of strawberry pulp & Orange pulp on chemical composition of Popsicles

Treatments	Fat	Protein	Moisture	Ash	pH
T1	9.60	4.16	63.4	0.82	6.25
T2	9.55	4.21	62.8	0.85	6.18
T3	9.40	4.38	62.6	0.87	5.82

Table 4. Sensory analysis of different formulations tested for strawberry & Orange popsicle.

S #	Treatment	color	flavor	Texture	Appearance	Taste	Overall Acceptance
1.	T1	7.0	6.0	7.0	7.5	6.0	7.0
2.	T2	8.5	8.0	7.5	8.0	7.5	8.0
3.	T3	8.0	6.0	7.0	6.0	6.0	7.0

Table 4 shows the effect of treatments on sensory characteristics of the popsicles. The value of appearance, taste, flavour, body/texture and overall acceptability increased with the increasing level of strawberry pulp in the Popsicle. Popsicle having 20% strawberry pulp got highest score and minimum was given to Popsicle without strawberry pulp. During storage a slight degradation in sensory quality is observed. According to Palich (1994), with the passage of time, sensory quality of Popsicle deteriorated. Organoleptic properties of the

Popsicle decreased with increase in storage time and temperature (Mahran *et al.*, 1987). The mean score of the sensory evaluation is obtained for the variation (T2) by overall acceptability. Therefore, from the results it is concluded that the ice popsicles formulated with dehydrated strawberry and orange scored maximum score.

Nutritional analysis of the ice popsicles (T2) such as energy, carbohydrates, fat and vitamin C were performed and the results are shown in the table 5.

Table 5. Nutritional analysis of ice Popsicle

S.no	Nutrient	values
1.	Moisture (%)	62.8
2.	Ash (%)	0.85
3.	Energy (kcal)	31.6
4.	Carbohydrates (g)	3.50
5.	VitaminC (mg)	5.30

Dehydrated strawberry and orange ice popsicles are rich in vitamin and less in carbohydrates which can be taken by all age groups. High number of poly phenols and flavonoids are found in strawberries and oranges. Dehydrated strawberry and orange ice popsicles are a nutrient-dense snack option, providing a good amount of vitamins, minerals, and antioxidants. They are also low in calories, fat, and water content, making them a convenient and healthy choice for consumers. The energy content of the ice Popsicle was found to be 31.6± 0.70 kcal per 100g and the previous research work on whey-based ice popsicle was found to be 58.9 kcal per100g (Martins et al., 2018). The variation in the energy content could be attributed to the difference in the ingredients utilized to formulate the Popsicle.

Conclusion:

A new variety of popsicles particularly rich in chewy eating sensation and pleasant flavour can be manufactured by utilizing dehydrated strawberry and orange fruit. Appearance, taste and mouth feel characteristics of the popsicles improved upon the addition of the fruit. Based on overall statistical analysis of all attributes T2 was mostly preferred by sensory panel which has good flavor, smell, taste and offer nutritious element like vitamin c, k. Result of this study has revealed that addition of dehydrated strawberry and orange ice popsicles is convenient snack option that retains natural nutrients and anti-oxidants and had longer shelf life. The developed formulation is healthy and refreshment treat than commercial ice popsicles. Further research is recommended to establish the conditions for processing of strawberry fruit in different forms and levels of addition in popsicles without compromising the quality of the product.

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