Original Research Article

Formulation and Quality Evaluation of Kokum-Dragon Fruit Ice Pops

ABSTRACT:

To develop Kokum-Dragon Fruit Ice Pops as a functional additive free frozen dessert and assess their physico-chemical, nutritional and sensory qualities in comparison to commercially available synthetic Ice Pops. Ice Pops are frozen desserts which traditionally consists of water, sugar and synthetic colours. Experimental, lab-based food product development and study evaluation method was used. Kokum is chosen as an ingredient due to its sour-sweet taste and wide range of health benefits. Dragon Fruit is an under-utilized fruit from Maharashtra which is packed with antioxidants benefitting consumer health. The amount of sugar in the Ice Pops gives a sudden boost of energy and its frozen nature adds refreshment after consumption. These Ice Pops were evaluated using physico-chemical analysis, proximate analysis, and sensory evaluation. In these Kokum-Dragon Fruit Ice pops the Carbohydrate count is 9.1 ± 0.45 %, Protein is 0.14 ± 0.06 %, Fat is 0.05 ± 0.01 %, Ash is 1.08 ± 0.03 %, TSS is 12 ± 0.50 ^{0}Bx, Moisture is 89.2 ± 0.8 %, pH is 2.5 ± 0.15. The overall score achieved in sensory evaluation is 8.24. This study presents that Kokum-Dragon Fruit Ice pops are better than traditionally available, additives filled Ice pops.

Keywords: Kokum, Dragon Fruit, Ice Pops, Antioxidant, Carbohydrate.

1. INTRODUCTION:

Dragon Fruit is widely grown in Maharashtra due to its sub-climatic conditions. Dragon Fruit is chosen as an ingredient because it is an under-utilized fruit which is full of nutritional health benefits {1}.Dragon Fruit is rich in bioactive phytochemicals such as flavonoids, phenols, anthocyanin and betalains which contribute to its health effects {2}. Kokum is abundantly grown in Konkan region of Maharashtra. It is readily used in local cuisines and Ayurveda. Garcinol is a poly-isoprenylated benzophenone purified from Kokum fruits shows antioxidant, anticancer and anti-ulcer properties {3}. Ice Pops have a huge market in Maharashtra as well as other parts of India. They are sweet frozen treats which usually consists of flavour, sugar, and water. Ice pops are the frozen thin cylindrical blocks packaged in Low Density Polyethylene (LDPE) material. The traditionally available Ice Pops have no specific nutrition and are filled with synthetic additives and sugar. Although synthetic additives are legally permitted in food products to enhance appearance and shelf life, over consumption may have negative health effects. Over consumption of these can lead to adverse effects on mental health by significant increase in cardiovascular diseases, Attention deficit hyperactivity disorder (ADHD), metabolic syndrome, etc {4}. Kokum-Dragon Fruit Ice Pops contain real juice of Kokum and Dragon Fruit whereas traditionally

synthetic flavours and artificial colours are used. There are few existing solutions for this problem. A research has been previously conducted on the formulation of Vegetable and Herb Ice Pops. These healthy ice pops are not close to taste and flavour with respect to the traditionally available ice pops {5}. Kokum-Dragon Fruit Ice Pops include ingredients healthier than traditionally used raw materials. These ice pops were referred as a different category of frozen treats rather than healthier alternatives to traditionally available frozen desserts. The Kokum-Dragon Fruit Ice Pops aim to reach as an alternative for traditional Ice Pops. Kokum and Dragon Fruit have proven health benefits which are added as a real fruit ingredient. These real fruits have better nutritional content than added flavours and colours. These Ice Pops are a great way to deliver antioxidants, flavonoids, anthocyanins, and many other beneficial nutrients.

2. METHODOLOGY:

2.1. Selection and Procurement of Raw materials:

The Dragon Fruit has been selected from Loni Kalbhor region of Pune, Maharashtra, India. The variety of *Hylocereus undatus* has been selected due to its white fleshy and juicy nature {6}. The Kokum selected is *Konkan Amruta* variety. It is widely grown in Konkan region of Maharashtra. This variety is chosen because of its mildly sweet and acidic taste {7}. Along with this table sugar was selected for added sweetness.

2.2. Preparation of Ingredients used for Kokum-Dragon Fruit Ice pops:

2.2.1 Process Flowchart : Preparation of Dragon Fruit Juice:

Selection of Ripe Dragon Fruit

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Washing & Cleaning

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Peeling

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Juice Extraction

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Filtration (0.22mm pore size) and Clarification of juice

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Pasteurization (85-90^{0}C for 15-20 sec)

↓

Cooling

2.2.2 Process Flowchart : Preparation of Kokum Juice

Selecting Ripe Kokum Fruit

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Fruit Cutting and Deseeding

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Juice Extraction

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Filtration (0.22mm pore size) and Clarification of juice

↓

Pasteurization (80-90^0 C for 15-20 secs)

↓

Cooling

2.2.3 Process Flowchart : Preparation of Kokum- Dragon Fruit ice pops

Obtaining distilled water

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Addition of sugar

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Filtration (0.22mm pore size) of Sugar and Water solution

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Adding Filtered Kokum juice and Dragon Fruit juice to sugar and water solution

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Pasteurization (80-90^0 C for 15-20 secs)

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Pouring into LDPE cylindrical packaging material

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Freezing at -18°C to -20°C

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Cold Storage

2.3. Physico-chemical analysis:

Physico chemical properties refer to characteristics that can be measured and observed. Physical and chemical changes in each constituent and ingredient result from processing operations and often lead to physical, sensory, and nutritional changes in food, and therefore, in the quality. These physico-chemical properties are used to characterize each type of food . This encompasses both physical and chemical attributes influencing food quality, safety, and stability. These properties include boiling point, melting point, odor, colour, chemical reactivity {8}.

2.4. Proximate analysis:

Proximate composition of a food product is crucial to determine and identify the nutritive values, chemical changes and any reaction that could have happened during handling, processing, and storage of the product. Understanding the proximate analysis of food helps to state numerous food applications. This helps in understanding the commercial and industrial scale of the product. Proximate analysis includes characteristics of Carbohydrates, Protein, Fat, Ash, Moisture Content {9}. These results are bound to change over the course of time. To avoid these changes the product should be packaged in material which has low Water Vapor Transfer Rate. Carbohydrate content for Kokum-Dragon Fruit Ice pops was determined by Calculation Method {10}. Protein content for Kokum-Dragon Fruit Ice pops was determined by Kjedahl Method {11}. Fat content for Kokum-Dragon Fruit Ice pops was determined by Soxhlet Method {12}. Ash content for Kokum-Dragon Fruit Ice pops was determined by Muffle Furnace Method {13}. Moisture content of Kokum-Dragon Fruit Ice pops was determined by Gravimetric Method {14}. TSS content for Kokum-Dragon Fruit Ice pops was determined by Refractometer Method mentioned by unit ^{o}Bx {15}. pH content for Kokum-Dragon Fruit Ice pops was determined by pH meter Method {16} .

2.5. Sensory Analysis:

Sensory analysis was conducted for the checking the acceptability of the product on characteristics like flavour, appearance, mouthfeel, texture, sourness, sweetness, overall acceptability of product with the help of 9-point hedonic scale which ranges from 1 being dislike extremely to 9 being like extremely. The sample size for this evaluation was [redacted] valuators. The sensory evaluation of the product was conducted by recording individual scores given by evaluators. The sensory evaluation score was calculated by taking average of all the scores {17}.

3. RESULT AND DISCUSSION:

Table 1: Physio-chemical analysis of Kokum-Dragon Fruit Ice Pops

Property	Result
Colour	Deep pink to reddish purple
Odor	Mild fruity and tangy aroma
Melting point	-1^0C To -3^0C
Boiling point	Not applicable
Chemical Reactivity	Sensitive to heat, light, and pH shifts; stable when frozen.

3.1. Physico-chemical properties of kokum-dragon fruit ice pops

1. **Colour :**
   Natural pigments in dragon fruit (betalains) and kokum (anthocyanins) are responsible for deep pink to reddish purple colour {18} which gives freshness and enhances visual appeal which was attracted by number of consumers.

2. **Odor :**
   The natural volatile compounds present in kokum (garcinol and hydroxycitric acid derivatives) {19} and dragon fruit are responsible for mildly fruity and tangy aroma which plays key role in sensory perception and consumer acceptance.

3. **Melting point :**
   The melting point is estimated to be between -1^0C TO -3^0C. The TSS and the presence of sugars and acids which depress the freezing point {20}.

4. **Boiling point :**
   Not applicable for frozen treats.

5. **Chemical reactivity :**
   It should not be stored under high temperature which may lead to the loss of pigments, vitamins, antioxidants and also can change the colour due to pH {21}.

Table 2: Proximate Analysis of Dragon Fruit Juice

Nutritional Information	Values
Carbohydrates	9.75 ± 1.25%
Proteins	0.35 ± 0.05%

Ash	0.4 ± 0.10%
Total soluble solids	10.2 ± 0.18 ^{0}Bx
Titrable acidity	0.22 ± 0.07%
pH	5 ± 0.14
Fat	0.15 ± 0.05%
Moisture content	88.5 ± 1.5%

Table 3: Proximate Analysis of Kokum Juice

Nutritional Information	Values
Carbohydrates	9.25 ± 0.75%
Proteins	0.3 ± 0.1%
Ash	0.4 ± 0.1%
Total soluble solids	11 ± 0.35^{0}Bx
Titrable acidity	3.15 ± 0.65%
pH	2.8 ± 0.12
Fat	0.15 ± 0.05%
Moisture content	89 ± 1%

Table 4: Proximate analysis of Kokum-Dragon Fruit Ice pops:

Nutrients	Value
Carbohydrates	9.1 ± 0.45%
Proteins	0.14 ± 0.06%
Fats	0.05 ± 0.01%
Ash	1.08 ± 0.03%
TSS	12 ± 0.50^{0}Bx
Moisture	89.2 ± 0.8%
pH	2.5 ± 0.15

3.2. Nutritional information:

3.2.1. Moisture content :

The moisture present in Ice Pops was found to be 89.2% as the product primarily composed of water which contributes to soft texture and also helps in maintaining products juiciness and mouthfeel. The

water content in Dragon Fruit Juice and Kokum Juice is higher along with added water which helps in freezing of the product. This contributes to overall increase in moisture content of the product.

3.2.2. TSS :

The TSS present in the Ice Pop was found to be 12 ^{0}Bx which indicates the presence of sugar, acids, and vitamins. Which contributes to balanced sweetness by meeting consumer expectations. This TSS consists of sugar already present in Dragon Fruit Juice, Kokum Juice and externally added sugar for enhanced sweetness and flavour.

3.2.3. Carbohydrates :

The carbohydrates present in Ice Pops was found to be 9.1% due to high natural-sugar content in dragon fruit and kokum. Which contributes to mildly sweet taste while keeping it health-conscious. The product being primarily water based does not consist of high quantity of carbohydrates except externally added sugar {22}.

3.2.4. Protein :

Low protein was found that is 0.14%. Neither kokum nor dragon fruit are significant source of protein {23}. This could be the reason of low protein content as it has minor effects on products texture and stability.

3.2.5. Fat :

The fat present in product was found to be 0.05% as the product is watery product due to which fat content is negligible which makes good option for the health-conscious consumers avoiding fat rich products. Kokum and Dragon Fruit are not significant sources of fat, which is the reason for very little trace of fat in the product.

3.2.6. Ash :

Total mineral content of the product is 1.08% which indicates the presence of essential minerals which can provide medicinal and nutritive benefits. Minerals like magnesium, potassium, calcium etc are present. Both Kokum and Dragon Fruit are good sources of Minerals which add to the ash content of the product.

3.3. Sensory evaluation :

3.3.1. Appearance (Score-8)

The visual appeal of the product is excellent. Appearance is pleasant due to the vibrant deep pink to reddish purple colour from dragon fruit and kokum.

3.3.2. Texture (Score-7.7)

Texture which indicates pleasant consistency and not too grainy and icy, helps consumer to enjoy the ice pops.

3.3.3. Flavour balance (Score-7.9)

The flavour balance is having acceptability. Contributes to a balanced sweet and sour flavour and not too overwhelming.

3.3.4. Sweetness (Score-7.8)

The sweetness was highly acceptable to panelists due to presence of natural sugar content and sweetness from dragon fruit and kokum respectively.

3.3.5. Sourness (Score-7.4)

Sourness has lowest scoring attribute. Kokum has little sour flavour which was accepted by panelists.

3.3.6. Mouthfeel (Score-8)

Score for the mouthfeel is very high because it has pleasant after taste and the Ice Pop melts pleasantly in the mouth providing satisfying experience to the consumer.

3.3.7. Overall Acceptability (8.2)

The overall acceptability of product was found to be good as sweetness, sourness, mouthfeel was maintained properly for consumers. Everything is balanced and the product is well accepted as a whole product.

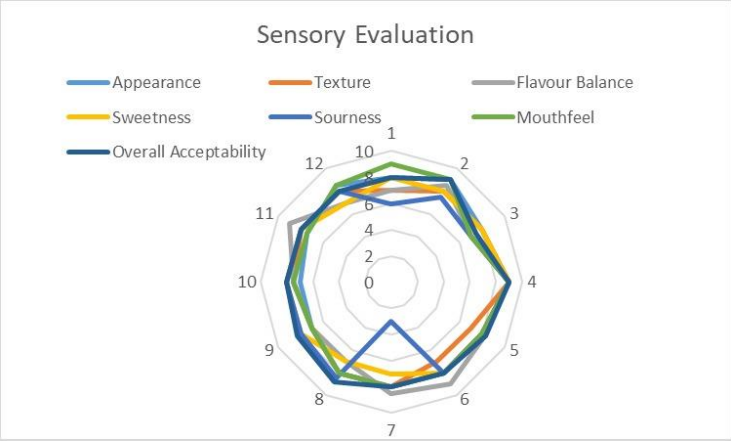

Figure 1: Sensory Evaluation of Kokum-Dragon Fruit Ice pops

4. CONCLUSION:

This formulation and study of the product was meant to formulate healthy version of traditional ice pops which qualifies as a healthy tropical fruit based frozen dessert. The blend of Kokum and Dragon Fruit juice increases health benefits and adds appealing flavour to the product. The choice of Dragon Fruit and Kokum adds to the antioxidant, anti-cancer, and anti-ulcer properties of the product. The thin cylindrical shape of these Ice Pops makes it convenient and interesting for consumption. This product has received an overall sensory score of 8.24. The product is rich in carbohydrates and moisture which is intended to hydrate in summer seasons and give a quick boost of energy. This study concludes that

Kokum-Dragon Fruit Ice pops which contain real fruit juice is better than traditionally available additives filled Ice Pops.

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