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NUTRITIONAL AND SENSORY IMPACT OF OAT MILK AND CARROT JUICE FORTIFICATION IN LOW-FAT VANILLA ICE CREAM

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ABSTRACT:

Ice cream, a popular frozen dessert, is constantly evolving to meet the demands of health-conscious consumers while maintaining its indulgent appeal. This study explores the formulation and quality evaluation of ice cream infused with oat milk and carrot juice, complemented by vanilla flavoring. Oat milk, known for its creamy texture and nutritional benefits, serves as a non-dairy alternative rich in fiber, vitamins, and minerals. Carrots, abundant in beta-carotene and antioxidants, are incorporated to enhance nutritional content and introduce a unique flavor profile. The experimental design involves varying concentrations of oat milk and carrot juice, with vanilla flavoring providing a complementary taste. Quality parameters including sensory attributes, texture and nutritional properties are assessed to ensure the acceptability and stability of the final product. The incorporation of oat milk and carrot enhances the creaminess and nutritional value of the ice cream while imparting a subtle sweetness and earthy undertones. The addition of vanilla flavor contributes to a well-balanced taste profile, appealing to a wide range of consumers. Furthermore, texture analysis reveals that the ice cream maintains its desired consistency and exhibits satisfactory melting characteristics. In conclusion, the development of oat milk, carrot and vanilla-flavored ice cream offers a promising approach to meet the evolving preferences of health-conscious consumers without compromising on taste and indulgence.

Key words: Oat milk, Carrot juice, Beta-carotene, Low-fat, Protein & fibre.

INTRODUCTION:

The liquid of white color having milk proteins, fats, lactose, vitamins and minerals which is the product of mammary glands produce by mature female mammals when the birth of child is occur and also serve it as a food for their child is mainly called as milk (Guetouache et al. 2014). In the ever-evolving landscape of alternative milk products, oat milk has emerged as a

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versatile and increasingly popular choice for consumers seeking a nutritious and sustainable dairy-free option. With growing concerns over the environmental impact of traditional dairy production, as well as the prevalence of lactose intolerance and milk allergies, the demand for plant-based milk alternatives has steadily risen in recent years. The frozen product that consists of a dispersion of air cells in a liquid matrix is called ice cream. The major structural components of ice cream are ice crystals, fat globules and air cells. They are distributed on the unfrozen liquid solution of the ice cream (Muse M R et al. 2004)

Oat milk: Oats are known as nutritious and wholesome grains which are a rich source of soluble fiber and dense nutrients. Independent of nutritionally rich grains, it also has several physiological benefits like beneficially outcome on diminishing hyperglycemia, hyperinsulinemia, hypercholesterolemia and several other advantages. Oats are excellent source of different β-glucans, arabinoxylans and cellulose. It contains incredibly high amount of protein, lipids (unsaturated fatty acids), vitamins, antioxidants, phenolic compounds and minerals. The primary part of the physiological effects of Oat soluble fibre is because of the elevation of viscosity (Wani et al. UJP 2014). Oat milk is a non-dairy milk substitute made by blending oats with water and then straining the mixture to create a creamy, milk-like beverage. The production of oat milk involves the disruption of plant materials to form aqueous suspensions of oil bodies, a process that allows for the extraction of the valuable nutrients and functional components present in oats. These include a favourable protein composition, dietary fibre (particularly beta-glucan) and a range of essential vitamins and minerals. The use of non-dairy ingredients to substitute cow's milk, such as fruits, legumes, tubers and cereals has been regarded and widely utilized as alternative materials for ice cream production (Ismail H A et al. 2022).

Carrot juice: Carrot juice renowned for its high vitamin and antioxidant content, is being explored as an innovative ingredient to enhance both the nutritional profile and the unique flavour of food products. Among common fruits and vegetables, carrots are high in fibers, carotenoids, vitamins C & E and phenolics such as p-coumaric, chlorogenic and caffeic acids (Alasalvar C et al. 2001). On the other hand, carrot juice is a powerhouse of nutrients, notably high in beta-carotene, which the body converts into vitamin A, essential for good vision, immune function and skin health. The nutrients including fiber, potassium, nitrates, and vitamin C could have contributed to the effect seen in lowering systolic blood pressure (Agudo ACL et al. 2007). Carrots are a rich source of nitrates, which may be converted into nitric oxide to increase vasodilation, possibly decreasing blood pressure (Raat NJ et al. 2009). Carrots have anticarcinogenic properties as well as ability to decrease inflammatory insult & regulate immunological response (M. R. Alam et al. 2018). Incorporating carrot juice into ice cream adds a natural sweetness and a subtle earthy flavour, while simultaneously boosting the product's nutritional value. This combination can appeal to health-conscious consumers seeking to enjoy their favourite treats without compromising on health benefits.

Creating a low-fat ice cream using oat milk, carrot juice, and vanilla flavour involves overcoming several technical challenges, such as achieving the desired creaminess and preventing ice crystal formation without the high-fat content typically found in traditional ice creams. However, advancements in food technology and ingredient processing have made it

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possible to develop formulations that maintain the desirable texture and mouthfeel of full-fat ice cream while significantly reducing the fat content.

Materials and Methodology:

Materials:

Oat milk was bought from "So Good beverages" in online mode for sample 3. For the other two samples, the oat milk is obtained from the original oats which was bought online from "Manna Oats". The other ingredients such as skim milk powder, stabilizers & emulsifiers, sugar and water were supported by "Sri Srinivasa dairy products Pvt. Ltd". Whereas, the carrots were bought from the local vegetable market.

Methodology:

Preparation of oat milk:

Oats were washed with normal water and soak in 1 liter water for 4-5 hours at room temperature (RAUJ Marapana et al. 2018). Then the water is drained off and oats were blended with 100ml of water by using blender at low speed then blend oats and pass through cheesecloth. After that, it is heated for 10 minutes at 70 degrees Celsius. Cool down the oat milk at room temperature and then place it in refrigerator prior making the ice cream.

Preparation of Carrot juice:

Take the normal size of carrot and wash it thrice with normal water and boil it for 8-10 minutes. After boiling, cool and cut into pieces. Then blend the pieces to extract the juice and filter it.

Development of oat milk ice cream:

Ice cream was prepared from blend of 50% of oat milk, water and skim milk powder. The mixture is heated for 10 mins, when the bubbles start to appear. The stabilizers and emulsifiers were added along with the sugar and heat up to the sugar is dissolved and cool it to room temperature. Then add 17% of carrot juice and the mixture is churned by beater. After that the ice cream mixture is placed in freezer at -4 degrees Celsius for 4 hours and churning of ice cream is carried and keep it in freezer for 7-8 hours at -18 degrees Celsius.

To standardize the oat milk ice cream, different formulations were taken namely sample1, sample 2 and sample 3. The formulation was given in the table below**:**

Table 1: Variation in samples with specific measured ingredients

Ingredients	Sample 1	Sample 2	Sample 3
Oat milk	50g	46g	48g
Carrot juice	15g	18g	15g
Skim milk powder	5.0g	5.5g	6.3g
Sugar	14g	14g	14g
Stabilizer & Emulsifier	0.4g	0.4g	0.4g
Water	15ml	15.5ml	15.7 ml
Vanilla essence	2 drops	2 drops	2 drops

Pysico-chemical analysis:

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Protein:

Reagents -Biuret reagent. Dissolve 3 g of copper sulphate (CuSO4.5H2O) and 9 g of sodium potassium tartrate in500ml of 0.2 mol/liter sodium hydroxide; add 5 g of potassium iodide and make up to 1 liter with 0.2 mol/liter sodium hydroxide. 25 Protein Standard: 5 mg BSA/ml.

Procedure: Pipette out 0.0, 0.2, 0.4, 0.6, 0.8 and 1 ml of working standard in to the series of labeled tubes. Pipette out 1 ml of the given sample in another test tube. Make up the volume to 1 ml in all the test tubes. A tube with 1 ml of distilled water serves as the blank. Now add 3 ml of Biuret reagent to all the test tubes including the test tubes labeled 'blank ‘and 'unknown'. Mix the contents of the tubes by vertexing / shaking the tubes and warm at 37 ºC for 10 min. Now cool the contents to room temperature and record the absorbance at 540 nm against bank. Then plot the standard curve by taking concentration of protein along X-axis and absorbance at 540 nm along Y-axis. Then from this standard curve calculate the concentration of protein in the given sample. (Hanne K et al. 2018)

Calculations:

OD of test (optical density)

Total protein (g o) =X Concentration of standard OD of standard.

Fat:

The crude e fat content of the samples was estimated by crude ether extract of the sample using AOAC (1990) method.

Procedure: The dry sample (-10) was weighed accurately into a thimble (made with Whatman no1 filter paper). Thimble was placed in the fat extraction tube of the Soxhlet apparatus and extracted with netroleum ether (60-80oC B.P.) for about 16hrs. The ether extract was filled into a weighed beaker and flask was rinsed four to five times with small quantities of petroleum ether and added to the beaker. Petroleum ether was removed by evaporation and the flask was dried with the residue in an oven at 80-1000C and was cooled in desiccator and weighed.

Calculations:

Weight of ether extract x 100

Fat content (%) of the sample = Weight of sample Inversion to take place, and then makeup to mark with distilled water (Mario Hoernicke et al. 2012).

Molisch’s Test:

1. In a clean test tube, take 2 ml of a given sample,
2. Add 2-3 drops of Molisch reagent slowly.
3. Now add concentrated sulphuric acid and the acid forms a layer at the bottom.
4. If there is a formation of a violet ring between the junction of two layers then the presence of carbohydrates is confirmed.
5. Thus, carbohydrate is present (Muhammad Asif et al. 2011)

Results and Discussion:

The developed ice cream had a smooth texture and a light, mildly sweet flavor. The carrot juice imparted a pleasant orange color and a subtle earthiness. Sensory evaluations showed positive responses for its refreshing taste and creamy consistency, despite the reduced fat content. Nutritionally, it offered dietary fiber from oat milk and beta-carotene from carrot

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juice, making it a healthier, dairy-free dessert option without compromising on taste or texture.

Quality Evaluation:

Appearance: The ice cream boasts a creamy, smooth texture with a warm, inviting light orange colour. The vibrant hue from the carrot juice is softened by the addition of oat milk and vanilla, creating a visually appealing dessert.

Flavour: The ice cream offers a unique flavour profile, where the subtle sweetness of vanilla perfectly complements the earthy sweetness of carrots. The oat milk adds a gentle, nutty undertone that enhances the overall taste. The blend of vanilla, carrots and oat milk creates a refreshing and wholesome flavour that is both satisfying and intriguing.

Texture: The texture is rich and velvety, characteristic of a well-made ice cream, with a slight graininess from the oat milk. This adds an interesting mouthfeel without being overly gritty. The creamy consistency is smooth and melts pleasantly on the tongue, making each spoonful a delight experience.

Sensory Evaluation:

Sensory evaluation is one of the important criteria for analysing and accepting of any food product by means of sense, taste, touch (Manoharan et al. 2012). The sensory evaluation for oat milk ice cream is carried to evaluate the acceptability on the basis of texture, colour & appearance, taste, flavour, mouthfeel and overall acceptability by using nine – point hedonic scale method by 8 trained panel members. Based on the results of the sensory evaluation any one of the variations will be selected for further analysis. (Jenny joseph et al. 2015).

Tabel 2: The organoleptic scores of developed low-fat oat milk cream was given below.

Parameters	T1	T2	T3
Colour and Appearance	9	7	8
Texture	8	7.5	8
Taste	9	7	8
Flavor	8.5	7.5	7
Mouth feel	9	8	8
Overall Acceptability	9	7.5	8

Hedonic Scale: 9-Excellent, 8-Very Good, 7-Good, 6-Slightly Like, 5-Neither Like nor Dislike, 4-Dislike Slightly, 3-Dislike Moderately, 2-Dislike, 1-Dislike Very Much

Therefore, the mean score of the sensory evaluation is obtained for the sample 1, by overall acceptability. It is concluded from the results that the oat milk ice cream of sample 1 scored the maximum. Hence, it is subjected to further quality evaluation.

Physical characteristics:

The samples of ice cream were analyzed for the physical properties after 24 hours storage period. The pH was measured using pH – meter, the viscosity of oat milk ice cream was found to be 38. 24mPa.s, which is higher than the viscosity of oat milk (14. 44mPa.s), total solids – in oat milk ice cream were found to be 38.5%, which is within the standard range of 29.99 to 48.66%. Over run – the overrun of oat milk ice cream was calculated to be 16.96%, which is lower than the overrun percentage of ice cream made from 100% whole milk (53.51%) (Sevim Kaya et al. 2001). Moisture loss – the moisture loss from oat milk ice cream

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was found to be 19.40%, which is higher than the moisture loss from the oat milk (12.70%), Textural properties – the developed low-fat oat milk ice cream shows a unique texture of orange colour with soft consistency that is distinct from traditional ice cream.

S. No	Formulation	Sample1
1	Energy	130kcal
2	Protein	3.0
3	Carbohydrates	24
4	Fiber	0.5
5	Fat	2.2

Table 3: Physical properties of the developed ice cream

Nutritional characteristics:

The nutritional characteristics of the developed ice cream includes – calories, protein, carbohydrates, fiber and fat. Where the calories are lower compared to traditional ice cream due to reduced fat content and it lowers the fat level. Carbohydrates from oat milk and natural sugars from carrot juice contribute to creaminess and texture. Protein and fiber primarily from the oat milk – provides a beneficial amount of soluble fiber. Beta-carotene from carrot juice which is rich in it. Overall, this ice cream offers a nutritious, low-fat and dairy-free option.

S. No	Physical Properties	values
1	Moisture	78
2	Ash	0.80
3	pH	6.5
4	Total Solids	27

Table 4: Nutritional characteristics of the developed ice cream

Conclusion:

The low-fat oat milk and carrot juice ice cream presents an innovative, nutritious alternative to traditional dairy-based ice creams. It combines the creamy texture of oat milk with the natural sweetness and vibrant colour of carrot juice, resulting in a unique flavour profile that appeals to health-conscious consumers. This ice cream is lower in calories and fat, making it suitable for those seeking a lighter dessert option. Nutritionally, it offers the benefits of dietary fibre from oat milk and beta-carotene from carrot juice, which supports eye health and immune function. Additionally, the inclusion of fortified oat milk can enhance the ice cream's calcium and vitamin D content, further contributing to its health benefits. Overall, this ice cream provides a delicious, dairy-free treat that does not compromise on taste or nutritional value, making it an excellent choice for a wide range of dietary preferences and health goals.

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