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Process standardization of multi-seed and fruit based spread incorporated with canary melon

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Abstract

Canary melon, also known as sun melon and winter melon, is a fruit of species *Cucumis melo* from the family of *Cucurbitaceae*. It is commonly used as a dessert fruit around the world as it is sweet in taste with TSS of around 8.8. The study was undertaken with an objective to develop an alternative for sugar enriched spread available in the market. The use of five super seeds was done which are pumpkin seeds, sesame seeds, flax seeds, sunflower seeds and chia seeds. Along with it fruit pulp of apple and banana was used and for consistency the pulp of canary melon was incorporated. The combination provides a balanced nutritional profile without compromising on sensory characteristics. The sweetness of spread was maintained using dates pulp and for flavor cinnamon powder was used. The sensory evaluation of spread was performed using 9-point Hedonic Scale. The most acceptable spread was then analyzed for proximate composition, microbiological analysis and sensory evaluation. The spread has carbohydrates content 38.601 g/100 g, fat content 17.914 g/100 g, ash content 17.75%, protein content 14.875 g/100 g, moisture content 7.74%, and fiber content 3.120 g/100 g.

Keywords: Canary melon, five super seeds, fruit pulp

Introduction

With the growing health-conscious population, there is a consistent growth in demand for nutrient dense, low sugar spreads as an alternative for sugar rich spreads available in the market. Nut butters and nut spreads are spreadable products made from nuts that are ground into paste [1]. Similar spreads can also be made from other seeds such as sesame seed, pumpkin seed, flaxseeds and sunflower seeds, but they are not categorized as nuts spread. These seeds are considered as superfoods with power pack of nutrition, protein and fibers. Pumpkin seeds are rich source of zinc, essential amino acids, minerals and fatty acids. Chia seeds are rich in omega fatty acids and calcium. Sunflower seeds are rich source in magnesium and monounsaturated fats [2]. Apples are the fruit of the *Malus* genus which are rich in soluble fibers, pectin and potassium, providing a base for texture, flavor. The natural source of pectin provides spreads gelling and overall structure. Banana pulp provides a creamy texture to the spread improving its spread ability and imparts a mild flavor that blends well with other fruit pulps. Canary melon plays a vital role in imparting natural sweetness to the spread, eliminating the need for artificial sweeteners or added sugar. A blend of nutrient dense seeds enriches the spread with nutty texture, healthy naturally present fats and thickening properties. Flaxseeds provides omega 3 fatty acids and fibers along with natural thickening and stabilizing properties. Chia seeds enhance the spread consistency by natural gel formation along with boosting fiber, protein and antioxidants. Soaked sunflower seeds provided enhanced creaminess and emulsification, improving the texture and consistency. Soaking of seeds increased the nutrient bioavailability by reducing the anti-nutrients like phytic acid. Similarly soaked sesame seeds contribute to natural oil release, improving the texture, mouthfeel of the spread while adding a mild nutty flavor. Sunflower seeds provide a subtle nutty flavor contributing to the overall texture and flavor along with Vitamin E and healthy fats. Pumpkin seeds are valuable source protein which can help in eradicating protein malnutrition and lipids (rich in PUFAs) contains essential as well as non-essential fatty acids. seeds of pumpkin are abundant in macro (magnesium,

phosphorous, potassium, sodium and calcium) and micro minerals (iron, copper, manganese, zinc and selenium), they can be used as an incredible dietary supplement [3].

Materials and Methods

Market Survey

There was a market survey carried out using a Google Form to obtain consumer feedback on sugar-free spreads. The survey was sent to different respondents to assess their interest in seed-based spreads, sugar-free preferences, and most loved flavours. The feedback provided insightful information on market trends that enabled us to identify opportunities and gaps for the development of multi-seed and fruit-based spread like product.

Procurement of raw materials

Raw materials like Apple, Banana, Dates, Chia Seeds, Flax seeds, Pumpkin seeds, Sesame seeds, Sunflower seeds, were procured from a local market in Loni Kalbhor, Pune, India. Canary Melon due to its limited availability was procured from online shops.

Development of product

Fruit and seed-based spread was developed using different seeds and fruit pulps. The sunflower and sesame seeds were first soaked in water for 8 hours and afterwards dried in a hot air oven at 70 °C for 6-8 hours. This was to minimize the excess amount of oil released by the seeds, which would have adverse effects on the final product texture and stability. At the same time Chia seeds, Pumpkin seeds were roasted in a microwave at 180 °C to preserve nutrients and flax seeds were roasted in an open pan to reduce the bitterness. The seeds were subjected to a dehulling process to break-off their shells followed by grinding into a powder. Apple, banana and canary melon were cut into thin slices and then steam blanched for approximately 3 minutes; to inhibit the enzymatic browning and then the slices were converted to pulp using mixer grinder and then stored in HDPE bags and kept in the refrigerator at 4°C. The prepared seeds powder and fruit pulps were blended, forming the base for spread formulation. After four trials, composition was finalized. In Trial 1 consistency was not appropriate, Trial 2 was overpowered by banana flavor with a bitter note from flaxseeds and chia seeds. Refinements during Trial 3, such as changes in canary melon, apple and banana pulp, enhanced the formulation.

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Table 1: Basic recipe of seed-based spread

Ingredients	Trial 1	Trial 2	Trial 3	Trial 4
Pumpkin seeds	1.65 g	3.125 g	3.125 g	3.125 g
Sunflower seeds	1.65 g	7.5 g	7.5 g	7.5 g
Sesame seeds	1.65 g	7.5 g	7.5 g	7.5 g
Chia seeds	1.65 g	3.125 g	3.125 g	3.125 g
Flax seeds	1.65 g	3.75 g	3.75	3.75 g
Apple pulp	25 g	25 g	12.5 g	22.5 g
Banana pulp	25 g	25 g	12.5 g	12.5 g
Canary Melon pulp	25 g	25 g	50 g	40 g

Based on the basic recipe a number of variations were made by incorporating Cinnamon powder and Dates puree for flavor. To enhance the taste of Cinnamon it was first roasted

and then grinded. Sodium Benzoate, Potassium Sorbate, TBHQ(Antioxidant), Acacia Gum (Emulsifier and Stabilizer) and KCL were used as preservatives. Sodium Benzoate, Potassium Sorbate, Acacia Gum and KCL were dissolved in warm water to reduce the chemical taste. Chemical preservatives were used as per the FSSAI guidelines.

Table 2: Trials With Flavors

Ingredients	Trial 1	Trial 2	Trial 3
Pumpkin seeds	3.125g	3.125g	3.125g
Sunflower seeds	7.5g	7.5g	7.5g
Sesame seeds	7.5g	7.5g	7.5g
Chia seeds	3.125g	3.125g	3.125g
Flax seeds	3.75g	3.75g	3.75g
Apple pulp	22.5g	22.5g	22.5g
Banana pulp	12.5g	12.5g	12.5g
Canary melon pulp	29.882g	29.782g	29.862g
Cinnamon powder	0.1g	0.2g	0.3g
Dates puree	9.5g	9.5g	9.5g

Sensory Evaluation

The sensory evaluation of the standard recipe and the variations was done on a semi-panel composed of professors in the School of Food Technology, MIT ADT University, Pune, India as well as the students studying in the same college using a 9-point hedonic scale [REF]. 20 such sensory reviews were taken.

Chemical Analysis

The chemical analysis of sample B that was most approved as per the sensory evaluation was done. The chemical parameters were moisture content, protein, fat, total ash content, carbohydrate and fiber.

The moisture content was measured using Oven drying method [4]. The estimation of protein was measured using Kjeldahl method [5]. The fat and carbohydrates were measured using Soxhlet method and Anthrone method respectively [6, 7]. The product was converted to ash in the muffle furnace [4]. The crude fiber was measured using Fiber analyzer [5].

Microbial Analysis

The freshly prepared sample was analyzed for microbial analysis. The microbial analysis for total plate count, yeast and mold and coliform test was done. The total microbial load was determined using nutrient agar. While for yeast and mold PDA (Potato Dextrose Agar) was used. EMB agar was used to analyze any presence of coliforms of Escherichia coli. The samples were diluted in order. For all the tests dilution dilutions of 10^{-1} , 10^{-2} , 10^{-3} , 10^{-4} , 10^{-5} , 10^{-6} were used. In laminar flow hood, 1 ml of diluted sample was poured on prepared media in sterile Petri plates, followed by even spreading using a sterile glass spreader. The nutrient agar and EMB plates were incubated at 37 °C for 24 hours and PDA at room temperature for 48 hours.

Results and Discussion

Results of sensory evaluation

The acceptability of the spread was measured and the variations was done using 9-point hedonic scale and a comparative study between the variations was done. The study reveals (Table no. III) that Sample B with 0.2% cinnamon was acceptable.

Acceptability of the control and its variations, Sample A and Sample B, was quantified through the use of a 9-point hedonic scale, and comparative evaluation across the variations. Outcomes reveal that Sample B had the highest level of acceptability by overall acceptability scores.

From Table, Sample C was ranked the best in color, which meant that it was most pleasing to the eye. The fact that some ingredients might have contributed to the improvement in the quality of the color is possible. Sample A was ranked lower than Sample B; nonetheless, it was more acceptable than the control sample. The control sample was ranked lowest, meaning that it was less acceptable in terms of its appearance compared to the other samples.

Table 3: Trials with Flavors Sensory evaluation of control and Variations

Sample	Color	Flav or	Texture	Mouthfeel	Overall acceptability
Control	7.57	7.25	7.20	7.425	7.36
Sample A	6.65	6.475	7.38	7.4	6.9
Sample B	7.3	8.233	7.6	7.94	7.84
Sample C	7.4	7.25	7.6	7.8	7.80

The general taste quality of Sample B was scored the highest, i.e., it had the best general taste quality. Sample A was given a lower flavour score than Sample B, but it was also more liked than the control sample. The lowest score went to the control sample, i.e., it lacked the desirable flavour characteristics in the other samples.

In texture, Sample B and Sample C were the highest, implying that it had the best texture. Sample A came second with a slightly better texture than the control sample. The control sample was the lowest, which can imply a relatively less desirable texture.

Regarding the taste, Sample B was ranked highest, thus being the most preferred in this aspect. Sample A was also preferred; however, its ranking was lower than Sample B. The control sample had the lowest ranking in taste, thus making it less pleasant compared to the other samples. The mouthfeel of Sample B and Sample C were both high (7.86), which means that both samples were more pleasant and had a better sensory experience than the control. The control was lower in this characteristic, which means that it was less desirable in mouthfeel.

The overall acceptability scores show that Sample B (7.84) was the most accepted, followed by Sample C (7.80). The control sample had the lowest overall acceptability score (7.36), which shows that the variations were more acceptable overall. The higher ratings in colour, flavour, and texture contributed significantly to the variations being more acceptable.

Result of chemical analysis

The nutritional value of the sample was established based on the chemical parameter estimation of the moisture content, total ash, protein, fat, total carbohydrate, and fiber. Such tests are beneficial in understanding the quality and stability of the product.

The 7.74% moisture content was measured, in which the sample was dried under controlled temperature and the weight loss was measured. A lower water content indicates that there is better shelf life and less microbial growth.

Protein content (14.875 g/100g) was estimated by the Kjeldahl method, where the nitrogen content in the sample is measured and then converted into protein using a standard conversion factor. Protein content is important to estimate the value of the product from the nutritional point of view.

The fat content was analyzed and determined to be 17.914 g/100g. The fat content is responsible for the energy value, texture, and mouthfeel of the product.

The total carbohydrate composition was found to be 38.601g/100g. The carbohydrates are the primary source of energy in food.

Ash content, which was 17.75%, was determined by burning the sample in a muffle furnace at high temperatures. Ash content is the total of mineral constituents of the product and is crucial in determining the micronutrient content.

The fiber concentration was determined to be 3.120 g/100g. Dietary fiber has a crucial function in digestion and gut health.

Table 4: Results of chemical analysis

Parameters	Final Product
Moisture Content (%)	7.74
Fat (g/100 g)	17.914
Protein (g/100 g)	14.875
Ash (g/100g)	17.75
Carbohydrate (g/100 g)	38.601
Fiber (g/100 g)	3.12

Additional analyses, including mineral content (calcium, phosphorus, and other nutritional elements) and antinutritional components (e.g., tannins, if any), can be performed to gain a better understanding of the product's nutritional and functional characteristics. Shelf-life testing under various storage conditions can also be performed to establish product stability and shelf life.

Microbial Analysis

Microbial test was conducted to examine the stability and safety of the product. The outcome was that no microbial growth was detected on day 1 storage, confirming the samples to be microbiologically stable and free from contamination over the tested period.

The absence of microbial growth confirms that the ingredients used, process conditions, and storage conditions were successful in preventing microbial contamination. This finding also contributes to the potential of product safety assurance in controlled environments. Further studies for a longer storage period may be warranted to determine the long-term microbial stability of the samples.

Conclusion

The creation and standardization of a nutrient-dense, naturally sweetened fruit and seed spread effectively met the demand for a healthier alternative to traditional sugar-based spreads. The product was made with five super seeds—pumpkin, sesame, flax, sunflower, and chia—and apple, banana, and canary melon pulp, resulting in a nutritionally balanced profile high in protein, good fats, fiber, and essential micronutrients. Date puree and cinnamon powder were incorporated to complement the natural sweetness and flavor, thus eliminating the use of refined sugar.

Improved critical processing techniques such as roasting, grinding, and pasteurization were utilized to preserve the nutritional value of the ingredients while ensuring microbial

safety. Sensory evaluation results indicated that the final product was extremely acceptable in terms of color, taste, texture, and overall acceptability and hence offers a healthy option for health-conscious consumers. Chemical analysis also confirmed the product's increased nutritional value with satisfactory amounts of protein (14.875 g/100 g), fat (17.914 g/100 g), and carbohydrates (38.601 g/100 g).

Microbial testing confirmed that the spread was safe to consume over its estimated shelf life of 30 days, which was also attested to by the intentional addition of mild food-grade preservatives such as sodium benzoate, potassium sorbate, and acacia gum. The findings of the present study support the market viability of the new spread as functional, natural, and clean-label spread that meets growing consumer demand for low-sugar, nutrient-rich, and minimally processed food products.

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Further research can be directed towards longer shelf-life testing, consumer acceptability testing, and commercial-scale producibility to further define the commercial viability of this product.

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