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Qualtity Evaluation and Microbial Analysis of Nutrient Dense Fudge Incoporated with Multi Seeds and Nut

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Abstract
Nutrient Dense Fudge is a wholesome energy-rich confection crafted with a blend of nutrient- packed seeds and nuts. The study was aimed to develop the Nutrient- Dense Fudge, a combination of almonds, sunflower seeds, pumpkin seeds, and watermelon seeds. The combination of Ingredients was roasted, ground. The mixture was further enriched with dark compound for flavor and fortified with additional micronutrients to enhance its nutritional profile. Sensory evaluation conducted by 30 semi trained panelists indicated that a formulation with 50% seeds and nuts incorporation was highly preferred for its taste, texture, and nutritional benefits. Nutritional composition analysis of the formulated fudge revealed that it provides 384.38 Kcal of energy, 8.6 gm of protein, 76.1 gm of carbohydrates, and 35.5 mg of Magnesium per 100 g. Microbial testing conducted on the 1st and 8th day indicated that the fudge exhibited minimal microbial growth. This Nutrient-Dense Fudge can be introduced to adolescent girls as a healthy snacking option to promote awareness on traditional and natural food choices.

Keywords: Omega 3 rich seeds and nut, compound chocolate, Production, Double boiling Methods, Nutritional Composition

1. Introduction

Millets are one of the oldest foods known to humans & possibly the first cereal grain to be used for domestic purposes. It is a cereal crop plant belonging to the grass family Graminae. The term millet refers to several types of small seeded annual grasses that belong to the species under five genera namely, Panicum, Setaria, Echinocloa, Pennisetum and Paspalum in the tribe Paniceae and one genus Eleusine, in the tribe Chlorideae. The origin of millet is diverse with varieties coming from both Asia and Africa. Millets have been main staples of the people of semi-arid tropics of Asia and Africa for centuries where other crops do not grow well. They have been cultivated since time immemorial. There are around 6,000 varieties of millet grown throughout the world. Millets are underutilized in many developed countries. There is an immense potential to process millet grains into value added foods. (Chandrasekara and shahidi, 2010).

The combination of multi seeds—watermelon, pumpkin, and sunflower—with almonds in chocolate offers a unique taste and nutrition, appealing to both health-conscious consumers and indulgent treat

seekers. This innovative product leverages the rich nutritional profiles of these seeds and nuts to create a functional yet delicious confectionery option. Watermelon seeds are packed with essential nutrients such as magnesium, iron, and zinc, supporting overall metabolic and cardiovascular health (Betty Tabiri et al.,2016).

Pumpkin seeds are an excellent source of zinc, magnesium, and plant-based proteins, aiding in immune support and energy production (Dipali saxena., 2022). Sunflower seeds provide high levels of vitamin E, selenium, and healthy fats, offering antioxidant benefits and promoting heart and skin health (Yamunadevi Puraikalan et.al,2022). Almonds further enhance the chocolate's nutritional value with their rich content of vitamin E, magnesium, monounsaturated fats, and dietary fiber, contributing to brain function, heart health, and weight management (Mubeen asad et.al.,2022). This study was aimed to develop and evaluate the quality of prepared Nutrient- Dense Fudge, incorporated with almonds and multi seeds like sunflower seeds, pumpkin seeds, and watermelon seeds.

2. Methodology

The materials and methods of the study was carried out under following headings;

2.1.Multi Seed and Nut fudge

The materials required for the preparation of Multi seed and nut fudge are compound chocolate, sunflower seed, pumpkin seed, watermelon seed and almond. Procurement of required seeds and nut from the local market. Selection of ingredients is based on quality, certification, pricing. to ensures better texture, taste, flavor and proper product consistency

2.2. Method of processing of Multi Seeds and Nut Fudge

The method of processing of nutrient dense multi seeds and nut fudge involves the following steps;

2.2.1. Roasting

Roasting of seeds and nut enhances their flavor, texture, and shelf life. The process of roasting involves applying soted in a pan dry heat. It helps to develop a crunchy texture, releases natural oils, and improves aroma. Roasting can also reduce moisture content, making seeds and nut more stable for storage. Roasting also influences the nutritional composition of seeds and nut. While it can enhance digestibility and increase the antioxidant activity , which occurs during roasting, contributes to the development of rich flavors and golden-brown coloration.

2.2.2. Chopping

Chopping of the ingredients like Seeds and Nut involves cutting them into precise, uniform pieces to ensure a consistent texture and even distribution in chocolate products. This process enhances the crunchy and flavor profile of chocolates while allowing for better integration into fudge.

2.2.3. Double boiling method

The double boiling method of chocolate, also known as the bain-marie method, is a gentle melting technique that prevents chocolate from burning. It involves placing chopped chocolate in a heatproof bowl set over a pot of simmering water. The indirect heat gradually melts the chocolate, ensuring a smooth texture without overheating. This method is widely used for tempering, making ganache, or preparing chocolate coatings. Stirring occasionally helps achieve even melting. Care must be taken to prevent water or steam from coming into contact with the chocolate, as even a small amount can cause it to seize and become grainy. The double boiling method is ideal for maintaining the delicate structure of

chocolate, as direct heat can scorch it or cause uneven melting. It is commonly used in professional and home kitchens (Larsson et al., 2019)

2.2.4. Addition of copped Seeds and Nut

Adding chopped seeds and nut to melted chocolate enhances its texture, flavor, and nutritional value. It is essential to ensure that the mixture is dry. For even distribution, the chopped pieces should be gently folded into the melted chocolate using a spatula. Proper mixing ensures that the nuts and seeds are evenly coated, preventing them from sinking or clumping.

2.2.5. Molding

Molding of chocolate is the process of pouring melted chocolate into shaped molds to create bars, pralines, or decorative figures. The molds can be made of plastic, silicone, or metal, each offering different levels of flexibility and detail.Before pouring, the chocolate must be properly tempered to ensure a smooth, glossy finish and a crisp snap. After filling, the molds are gently tapped to remove air bubbles and ensure an even distribution. The chocolate is then allowed to cool and set at room temperature or in a controlled cooling environment. Once fully hardened, the chocolates are carefully unmolded and can be further decorated or packaged (Tewkesbury H., 2000).

2.2.6. Refrigeration

Refrigeration of chocolate helps speed up the setting process and maintain its structure, especially in warm environments. it should be done carefully to prevent condensation, which can cause sugar bloom (a white, powdery surface) and affect texture. Chocolate should be placed in an airtight container before refrigeration to protect it from moisture and absorbing odors. Ideally, tempered chocolate is set at a controlled cool temperature rather than direct refrigeration. If stored in the fridge for long periods, chocolate should be brought back to room temperature gradually before use to prevent cracking or dullness.

2.3. Organoleptic Evaluation for the prepared Multi Seeds and Nut Fudge

Development of multi seeds and nut done by mixing the copped seeds and nut in various proportions which is tabulated below;

Table I Multi Seeds and Nut Fudge developed with various proportions of Seeds and Nut

Sample	Chocolate (%)	Seed and nut (%)
Control (T)	100	_
V1	70	30
V2	50	50
V3	30	70

T : control : 100% Chocolate; A : 70% chocolate + 30% seeds and nut;
B : 50% chocolate + 50 % seeds and nut; C : 30% chocolate+70%seeds and nut.

The 9-point hedonic scale is a widely used tool in organoleptic sensory evaluation to assess consumer preference and satisfaction with regard to various products, particularly in the Food industry. It provides a structured method for individuals to rate their liking or disliking of a product based on their subjective experience. The scale ranges from 1 to 9, with 1 representing extreme disliking or "dislike extremely" and 9 indicating extreme liking or "like extremely". The formulated variations (Control,V1,V2,V3) V2

subjected to sensory evaluation using 30 semi trained panel members. Organoleptic evaluation will be done using 9-point hedonic scale and the scores given based on the table below;

2.4. Nutrient analysis of the Multi Seeds and Nut Fudge

The analysis of various nutrients like Carbohydrate, Fat, Protein, Fiber, Magnesium, Zinc, Vitamin B6 were done laboratory food safety and Standard Authority of India, Ministry of Health And Family Welfare, Government Of India, New Delhi (2015).

2.5. Microbial analysis of Multi Seeds and Nut Fudge

Microbial or Shelf life analysis of the selected Multi Seeds and Nut Fudge by finding the total plate count for the Day 1 (22.02.2025) and Day 8 (04.03.2025) in an interval of 8 days.

3. Results & Discussion

3.1.Sensory Evaluation of Multi Seeds and Nut Fudge

Sensory analysis (or sensory evaluation) is a scientific discipline that applies principles of experimental design and statistical analysis to the use of human senses (sight, smell, taste, touch and hearing) for the purposes of evaluating consumer products. Sensory Evaluation is a scientific method used to measure and examine reactions to foods as perceived by the five senses. Sensory Evaluation for the quality characteristics; including, appearance, colour, taste, texture, flavour and overall acceptability of the developed product (Multi Seeds and Nut Fudge) was carried out by 30 panel members [Semi-trained panel members and Consumer panels] with scoring each characteristic on 9-point Hedonic scale, Whereas the higher scores are denoting better quality as the following numerical system;

3.1.2. Mean Score for Sensory Evaluation

Sensory evaluation refers to the collective satisfaction or approval of a food product based on its sensory attributes, including taste, texture, aroma, appearance, and sometimes even factors like packaging and brand reputation. It represents the overall perception of the product's quality and desirability by consumers.

Table II Mean score for Sensory Evaluation

S.No	Criteria	Appearance	Colour	Flavour	Texture	Taste	Overall Acceptability
1	Standard	8.48	8.33	8.29	8.25	8.17	8.36
2	Variation 1	8.01	8.16	8.02	7.99	7.94	7.83
3	Variation 2	9.14	9.37	9.26	9.31	9.22	9.35
4	Variation 3	8.38	8.14	8.39	8.08	8.22	8.63

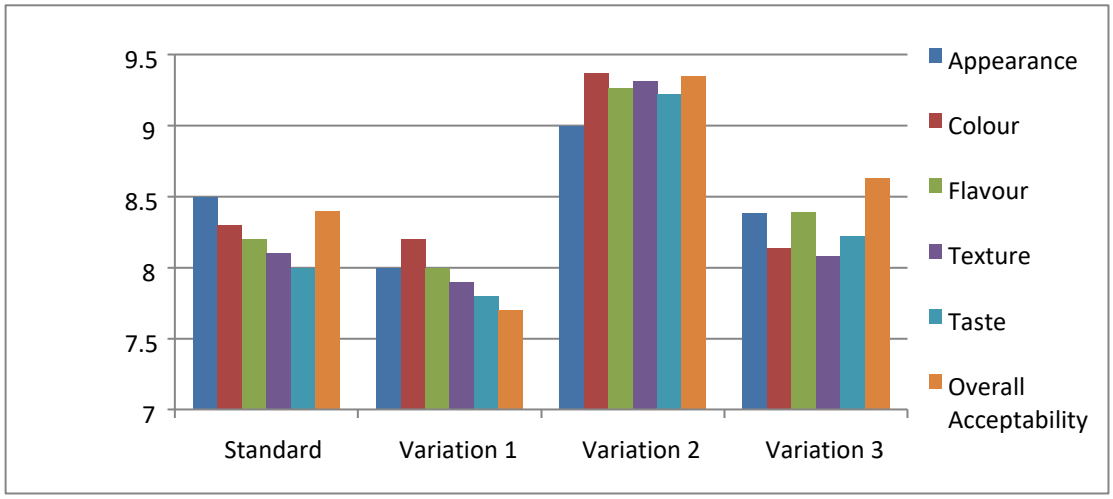

Figure 1 – Mean score for sensory evaluation

Mean score for sensory evaluation proves that, when compared with all the variations; variation 2 seems to be accepted.

3.2. Nutritional analysis of the Multi Seeds and Nut Fudge

The nutrient analysis of Multi Seeds and Nut Fudge offers valuable insights into its health benefits and nutritional composition.

Table III Nutritional analysis of Multi Seeds and Nut Fudge

S.No	Parameter	Result (Kcal/g/mg/µg)
1.	Moisture	7.32
2.	Ash	3.16
3.	Carbohydrate	76.1
4.	Protein	8.16
5.	Energy	384.38
6.	Fibre	2.36
7.	Magnesium	35.3
8.	Zinc	1.12
9.	Vitamin B6	6.95
10.	Fat	5.26

From the Nutritional analysis report, it is obtained as the Multi Seeds and Nut Fudge is rich in Magnesium, Vitamin B6, protein, carbohydrate and energy as their respective values.

4.4.Microbial (Shelf life) Analysis of prepared Multi Seeds and Nut Fudge

The shelf life or microbial analysis of the prepared Multi Seeds and Nut Fudge is given in the table below;

Table IV Microbial (Shelf Life) Analysis of the prepared Multi Seeds and Nut Fudge

S .No	Shelf Life (in Days)	Total plate count (CFU/gm)
1.	Day 1	0 x 101 CFU/gm
2.	Day 8	2 x 101 CFU/gm

The Microbial analysis of the prepared Multi Seeds and Nut Fudge showed 0 x 101 CFU/gm in the Day 1 and 2 x 101 CFU/gm in the Day 8.

Conclusion

Millets are highly nutritious, non-glutinous and non-acid forming foods. Hence they are soothing and easy to digest. They are considered to be the least allergenic and most digestible grains available. Due to urbanization, increase in health awareness and buying capacity among city dwellers, the demand for processed and convenience foods have increased drastically. Millets are much cheaper, but they have to be properly processed for further usage. Nutrition, sensory evaluation and microbial examination of the stated formulations were superior in quality but their texture was negatively affected due to improper texture of the fudge when compared to the control. Hence, there is a need to educate people about the health and nutritional benefits of millets to increase the consumption of millets and millet based products to save people from health and malnutrition related issues.

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