

FORMULATION AND STANDARDIZATION OF WHOLE MILK POWDER CHOCOLATE ENRICHED WITH KIWI FRUIT

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ABSTRACT

This study investigates the formulation and standardization of kiwifruit-enriched whole milk powder chocolate with the aim of creating a new confectionery product that combines the unique taste and nutritional value of kiwifruit with the creaminess of milk chocolate. The manufacturing process involves mixing whole milk powder, cocoa powder, sugar, and cocoa butter with finely ground kiwi powder. Lecithin and natural vanilla extract are added to improve texture and taste. The main challenges are to balance the acidity of the kiwis and ensure an even distribution in the chocolate matrix. The standard recipe, determined through repeated testing, contains 40% whole milk powder, 20% cocoa powder, 30% sugar, 8% cocoa butter, 1% lecithin and 1% kiwi powder. Quality control measures include sensory evaluations, nutritional analyses, and storage tests to ensure product stability and consumer acceptance. The final product promises a unique taste experience, combining the rich creamy texture of traditional milk chocolate with the refreshing spice of kiwi, while offering the potential health benefits of the fruit's vitamins and antioxidants.

INTRODUCTION

Fruits play an important role in our daily life. They are packed with high nutritional value and a wide range of Flavors. Fruits also play an important role in our health and healing. Kiwifruit has gained immense popularity in the last two decades. (Tyagi et al., 2015). It is a type of gooseberry native to northern China. Kiwis developed rapidly and the human-modified wild animals, which were only slightly abused by man, became an important commodity in foreign trade in the 20th century. The family of kiwifruit is Actinidia and the tribe Actinidiaceae.

Macaque peach, Mahout and Chinese gooseberry are other names for kiwi fruit. The genus Actinidia has 76 species, but only two of them are cultivated commercially: Actinidia chinensis (golden kiwi) and Actinidia deliciosa (mist kiwi), Actinidia polygama (silver kiwi), Actinidia mela Nandra (red kiwi), Actinidia purpurea (purple. kiwi), Actinidia arguta (baby kiwi), Actinidia Kolomitz (Arctic kiwi) and Actinidia arguta (baby kiwi) are some other species of action ids. China leads all countries in kiwifruit production, followed by Italy and New Zealand. Italy and New Zealand are the two largest exporters of kiwifruit in the world (Satpal et al., 2021). Kiwi fruit is an oval

fruit about 3 inches long with green flesh, white flesh, and brown hairy skin. The plant thrives in either full sunlight or light shade, and kiwi prefers slightly acidic soil with a pH of 6.0-6.5. Kiwifruit is mainly consumed fresh, but it is used to make juice, purees, candies, alcoholic beverages, dried, frozen and syrups. Kiwifruit is exceptionally high in vitamin C and contains many other nutrients such as folate, potassium, fibre, and levels of vitamin E that are important for nutrition, as well as various bioactive ingredients and various antioxidants, phytonutrients, and enzymes, which increase functional and metabolic benefits. It has properties such as antioxidant, anti-inflammatory and antimicrobial properties that prevent or help treat many chronic diseases. Kiwi has a pH of 3.1-3.9, so it is a very acidic fruit. It contains the cysteine protease actinidin, which has high milk coagulation activity (Puglisi et al., 2014).

Powdered milk, also called milk powder, Sikorski, Z. E. (2001). dried milk, or dry milk, is a manufactured dairy product made by evaporating milk to dryness. One purpose of drying milk is to preserve it; milk powder has a far longer shelf life than liquid milk and does not need to be refrigerated, due to its low moisture content. Another purpose is to reduce its bulk for the economy of transportation. Powdered milk and dairy products include such items as dry whole milk, non-fat (skimmed) dry milk, dry buttermilk, dry whey products and dry dairy blends. Many exported dairy products conform to standards laid out in Codex Alimentarius.

HEALTH BENEFITS: When consumed in moderation, milk chocolate offers several health benefits due to its nutritional composition. Although milk chocolate is often enjoyed as a delicacy, it contains ingredients that can have positive health effects: Source of Antioxidants, Heart Health, Energy Boost, Cognitive Function, Skin Health.

MATERIALS AND METHODS:

- Ingredients for Milk Powder Chocolate is Cocoa mass: 25%, Cocoa butter: 20%, Whole milk powder: 30%, Sugar: 24%, Emulsifier (lecithin): 1%, Freeze-dried kiwi powder: 5% of the total weight of the chocolate, Kiwi puree, or juice (optional): 2-3% for additional flavour and moisture content.
- Preparation of Kiwi Powder: Slice fresh kiwi fruits and freeze them., Place the frozen slices in a freeze dryer until

Table: 1 Formulations of kiwi fruit chocolate:

INGREDIENTS	T1	T2	T3
milk powder	5 g	5 g	5 g
kiwi fruit	2.5 g	3 g	4 g
cocoa powder	5 g	5 g	5 g
powdered sugar	5g	5 g	5 g
vanilla extract	1.5 %	1.5 %	2%

Table 2: Nine-point Hedonic scale:

Score	Grade
9	Like Extremely
8	Like very much
7	Like moderately
6	Like Slightly
5	Neither like nor dislike
4	Dislike slightly
3	Dislike moderately
2	Dislike very much
1	Dislike extremely

completely dried. Grind the freeze-dried kiwi slices into a fine powder. - Minifie, B. W. (2012).

3. **Chocolate Preparation:** Melt the cocoa butter and cocoa mass together in a cinching machine at 45-50°C until fully combined and smooth. - Beckett, S. T. (2008). Gradually add sugar and whole milk powder to the mixture, ensuring continuous mixing to maintain smoothness and consistency, Add the emulsifier (lecithin) to improve the texture and mouth feel of the chocolate. - (Afoakwa, E. O. (2010)). And add kiwi fruit into the chocolate. Continue cinching the mixture for several hours to develop the flavour and texture of the chocolate. The duration can vary but typically lasts between 12-48 hours, depending on the desired smoothness and flavour development. After cinching, temper the chocolate by cooling and reheating it in a controlled manner to ensure a glossy finish and proper snap. Use a tempering machine or perform manual tempering by cooling the chocolate to around 27°C and then reheating it to 31-32°C. - Beckett, S. T. (2017).

4. **Moulding and Setting:** Pour the tempered chocolate into Moulds; Tap the Moulds gently to remove any air bubbles. Allow the chocolate to set at room temperature or in a refrigerator until fully hardened. **Packaging:** Once the chocolate is fully set, remove it from the moulds and package it in airtight containers to preserve freshness and flavour. Gordon L. Robertson, (2012).



SENSORY EVALUATION:

Sensory evaluation of milk powder chocolates enriched with kiwi fruit. A reference to a sensory evaluation study on milk powder with kiwi fruit chocolate: “Sharma, A., and Pathania, S. (2016). This study would typically cover the methods and results of a sensory evaluation conducted on milk powder combined with kiwi fruit chocolate, including aspects such as taste, texture, aroma, and overall acceptability aster Testing Panels: * Conducted tests with consumers to refine flavour and texture. Meilgaard, Civille, and Carr, (2015).

By taking hedonic scale T3 is finalized product. And control is taken. And shelf life of product is 1 month. Leistner, L., & Gorris, L. G. M. (1995).

PHYSICO CHEMICAL ANALYSIS

TITRATABLE ACIDITY:

Preparation of Sample:

Take a known volume of the sample (usually 10-50 mL) and transfer it into an Erlenmeyer flask. If the sample is very acidic, you might need to dilute it with distilled water to bring the titration within a measurable Add 2-3 drops of phenolphthalein indicator to the sample. Phenolphthalein is colour less. In acidic conditions and turns pink in alkaline conditions, making it useful

for detecting the endpoint of the titration. Dennis R. Heldman, Daryl B. Lund, (2006).

Fill a burette with the standard NaOH solution. Record the initial volume of NaOH in the burette. Slowly add the NaOH solution from the burette to the sample while continuously swirling the flask to mix. By using a magnetic stirrer, place the flask on the stirrer and turn it on to maintain a consistent mixing rate. Watch for the first permanent colour change in the (Gaithersburg, MD, 2006) solution, which indicates that the endpoint has been reached. The solution should turn a faint

MOISTURE:

The moisture content of the sample was determined by using the method of (AOAC 2007)

Procedure:

1. The Petri dish with lid was weighed.
- 2.5 g of the sample was weighed into the Petri dish and spread evenly for uniform drying.
3. Oven was set at 100 to 105 and the Petri dish with sample was placed inside the oven with lip open for 15 - 17 hours.
4. The Petri dish was cooled in a desiccator with lid open for 1-2 hours.

The Petri dish with sample was weighed. This was prepared for all samples till constant weight was achieved.

$$\text{Calculations } (w_2-w_1) - (w_2-w_3) \times 100$$

$$\text{Moisture\%}=(w_2-w_1)$$

Where, W1=initial weight of the Petri dish(g)

W2=weight of the Petri dish with sample before drying (g)

W3=weight of the Petri dish with sample after drying (g)

PROTEIN:

Biuret Reagent: Dissolve 3 g of copper sulphate (CuSO4.5H2O) and 9 g of sodium potassium tartrate in 500 ml 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. 2. Protein Standard: 5 mg BSA/ml. Apparatus and Glass wares required: Test tubes, Pipettes, Colorimeter, etc.,

Procedure:

RESULTS AND DISCUSSION:

Sensorial analysis:

According to the results of sensorial evaluation of formulated variations along with control, the kiwi flavoured formulated milk chocolate which consists of 10gms of milk powder & 5gms of kiwi fruit (trail-3) demonstrated with a higher mean rank for the five attributes, in particular, colour, taste, flavour & appearance overall acceptability from sensory evaluation. The taste

Table no 3: Sensorial Analysis of developed formulations along with control:

Sensory Attributes	Control	Trail-1	Trail-2	Trail-3
Colour	9	7	8	9
Taste	9	8	9	9
Appearance	9	7	7	8
Flavour	9	8	7	9
Texture	9	7	8	9
Overall acceptability	9	7	8	9

Physico-chemical analysis:

pink colour that persists for about 30 seconds. Record the final volume of NaOH in the burette. Calculate the volume of NaOH used by subtracting the initial volume from the final volume. The titratable acidity is often expressed in terms of a specific acid, such as tartaric acid in wine or citric acid in fruit juices. Use the following formula to calculate the titratable acidity (Sadler et al.,2010) Titratable Acidity (g/L) = (Volume of sample (L)×Normality of NaOH × Equivalent weight of acid)

Pipette out 0.0, 0.2, 0.4, 0.6, 0.8 and 1 ml of working standard in to the series of labelled test 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 labelled 'blank' and 'unknown'.

Mix the contents of the tubes by vortexing / shaking the tubes and warm at 37 °C for 10 min.

Now cool the contents to room temperature and record the absorbance at 540 nm against blank

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. (Yoon Jung Park,2022)

Calculations:

OD of test (optical density)

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

pH:

To assess the acidity and alkalinity of the product.

Fat:

To determine the fat content Milk powder & Kiwi fruit incorporated in chocolate by using the Soxhlet extraction method.

$$\text{Fat content \%} = \frac{\text{weight of sample}}{\text{weight of extracted fat}} \times 100$$

Carbohydrates:

To determine the carbohydrates in the given sample by using the Fehling solution

attributes were rated very similar for two of the developed formulations. The texture of the product is slightly different and soft. Trail 3 is finalized as it is good in taste and its texture when compared to trail1and trail2. Trail 1 is rejected due to its taste and Trail 2 is rejected as it is not satisfying the attributes compared to other 2 formulations. It is preferable by all age groups because it has more energy and vitamin c content. Results of sensorial analysis were shown in table-3

Compared to the conventional dairy milk powder chocolate, these study findings indicates that there were some similitude in the outcomes for physicochemical properties of kiwi flavoured milk chocolate.

The results of physico-chemical analysis were expressed in the table-4

❖ **Table 3: Nutritional composition of kiwi flavoured chocolate:**

S.NO	NUTRITION QUANTITY	For (10 grams)
1.	Moisture	1.4 g
2.	Fat	1.0 g
3.	Protein	1.7 g
4.	Ash content	6.7 g
5.	Fiber	1.1 g

Kiwi's high moisture content presents a challenge in chocolate formulation. Excess moisture can lead to phase separation, affecting texture and shelf life. To address this, the incorporation of whole milk powder is essential as it helps absorb moisture, providing a creamy texture while maintaining structural integrity. However, careful balancing is required to ensure the final product does not become too dry or too moist. Preservation Techniques the high moisture content and enzymatic activity of kiwi can reduce the shelf life of the chocolate. Preservatives and proper packaging techniques, such as vacuum sealing or modified atmosphere packaging, can extend shelf life by minimizing microbial growth and oxidation.

Kiwi is rich in vitamin C and other antioxidants, which can significantly enhance the nutritional profile of the chocolate. This combination can appeal to health-conscious consumers looking for indulgent yet nutritious options. Studies have shown that the synergistic effects of combining different food items can amplify their health benefits.

Whole Milk Powder Contribution the inclusion of whole milk powder increases the protein and fat content of the chocolate, making it more satiating and potentially beneficial for muscle maintenance and energy. This can be particularly appealing to consumers interested in functional foods. Flavour and Aroma the unique combination of kiwi and chocolate can create a novel flavour profile that may attract adventurous consumers. The tartness of kiwi can balance the sweetness of chocolate, offering a refreshing taste experience. Sensory evaluations could reveal a high acceptance rate if the flavour and texture are well-balanced.

The introduction of a fruit-enriched chocolate product can create a niche market segment. Consumers are increasingly seeking novel and healthier options, and a well-formulated kiwi-enriched chocolate can tap into this demand. Market research and pilot studies could further validate the potential success of this product

The addition of kiwi may lower the melting point of the chocolate due to its moisture content, potentially affecting the product's stability at room temperature. This can be addressed by optimizing the formulation to achieve a desirable melting point. Textural properties, such as smoothness and creaminess, can be maintained by ensuring the proper integration of whole milk powder and emulsifiers (Di Monaco, R., Miele, N.A., Cabisidan, E.K., & Cavella, S. (2018). The flow properties of chocolate can be affected by the inclusion of kiwi. Adjusting the levels of emulsifiers and stabilizers can help achieve the desired consistency and ease of processing. Rheological studies can provide insights into the necessary adjustments to maintain product quality.

Ensuring optimal storage conditions, such as maintaining a cool and dry environment, is crucial for preserving the quality of kiwi-enriched chocolate. Regular quality control checks can help in monitoring and maintaining product standards throughout its shelf life.

CONCLUSION

The results of the present study concluded that the use of kiwi enriched of whole milk powder chocolate which increases vitamins, minerals, which helps to reduce carbohydrates it is rich in potassium and dietary fibre and improves skin keeps gut healthy. 3 different variations were formulated, among them the most accepted variation was trail 3 which was almost nearer to control. Successfully combines the creamy texture of milk chocolate with the nutritional value and unique taste of kiwi. Quality control measures, including sensory evaluations and nutritional analyses, ensure a consistent and attractive product. This new chocolate offers a delightful taste with additional health benefits and is designed for health-conscious consumers.

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