Incorporation of Bioluminescent Ingredients Extracted from Food Commodities to Give Night Light Effect in Ice Creams

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ABSTRACT

In this study, a new idea is presented, the development of quinine-containing ice cream capable of exhibiting luminescence. This is made possible through the use of a naturally occurring compound called quinine, which is extracted from the bark of a cinchona tree. The vulpine light can be generated when tonic water, which contains quinine, is exposed to ultraviolet radiation or black light which is predominantly found in nightclubs. This study focuses on the practical synthesis of quinine-infused ice cream containing the ideal quantity of the compound so that the balance between its luminescent properties and the flavor can be maintained. Taking into consideration the legal limit, it is important to note that both in Canada and the USA the maximal level of quinine in consumable products is established at 83 ppm. The FDA confirms that this concentration does not cause any hazards while making sure that a strong fluorescence effect is achieved. Quinine fluorescence can also be attributed to its functional groups, which contain nitrogen and are interspersed among aromatic rings. Ultraviolet light within the 350-360 nm range can also excite quinine molecules into an absorbing state, furthering the effect. This reference is also useful for explaining the blue light emission of the molecule, which appears when the electrons transition from an excited state back to a ground state and has wavelengths in the range of 450 - 470nm. Based on the nutritional analysis, the quinine ice cream consisted of 43.75% moisture, 1.00% ash content, 0.71% protein content, 15.90% fat content, 38.64% carbohydrates, caloric value of 292.40 kcal/100g and an overrun of 76.66%. However, the density that was 0.75g/cm3, ph. of 6.9 and viscosity of 2256.6cp are physical properties which show significance results regarding the structure and stability if an ice cream. This innovation not only contributes to the attractiveness of ice cream products but also opens up new horizons within the food industry.

Keywords: Black Light, Fluorescence, Quinine, Tonic Water, Ultraviolet.

INTRODUCTION

As the food industry evolves and matures, the consumers are looking forward to something much more than the traditional meals. Consumers nowadays are after products that will stimulate their sense of taste and bring temperature, texture and visual effects to the expectations of the products. In line with this vision, ice cream enriched with quinine is presented for the first time. These compounds are derived from plants and possess one or more nitrogen atoms making them basic in nature. Such organic substances cause a strong biological effect in both humans and animals ranging from excitatory to inhibitory action. Quinine (QN) which is the most active constituent of cinchona is utilized in beverages. Due to its effective anti-malarial action quinine was harvested from the bark of the tree and was mentioned as such by (Akhtar *et al*. 2020). Quinine was first described in the 17th century and was later extracted by two French botanists; Pierre Pelletier and Joseph Caventou in the year 1820. Quinine quickly became a widely used common remedy especially in the tropics. (David Greenwood 1992). It is often added to nonalcoholic effervescent drinks like tonic water whose original source was for medicinal use but consumers now like the strong bitter taste which is used in cocktails and other soft drinks. (Buleandra, Rabinca, Cheregi & Ciucu 2018). The maximum quantity of quinine recommended in drinks by The FDA is 83 ppm with the average commercial tonic water 25-60ppm, concentrations of tonic

water in the 19th century were significantly higher than the current levels (Donovan *et al*, 2003). Quinine's fluorescence mechanisms are however more of an interest to scientists. In these cases, while the two separate spectra are present at their respective wavelengths, when blue light (390 nm) is used for excitation the quantum yield is found to be 23% higher than when 313 nm uses for excitation. Both 6-methoxyquinoline and quinine exhibited similar red shifts of emission for excitation at 390 nm in comparison to excitation at 340 nm. In addition, the fluorescence polarization in the emission band of quinine indicates that two singlet states are operating concurrently. This unique feature of fluorescence implies that there is a non-evident electronic transition in its low energy electronic absorption spectrum long-wavelength absorption region (Drobnik *et al*, 1996). Quinine has the ability to inscribe energy in the form of ultraviolet light and release energy in the form of blue light due to its special structure. In the case of ice cream, colorants—usually tonic water with some quinine added to it—are added and mixed into the frozen product. Quinine glows under UV black light and gives off a bright blue color. The low temperature associated with ice cream does not hinder the fluorescence of quinine and hence the glowing effect can be seen in the presence of a black light (Phu *et al*, 2010).

OBJECTIVE

- Emphasizes the novelty of utilizing the fluorescence of quinine for cooking.
- Responding to the growing demand for interactivity and multi-sensory components within food.

MATERIALS AND METHOD

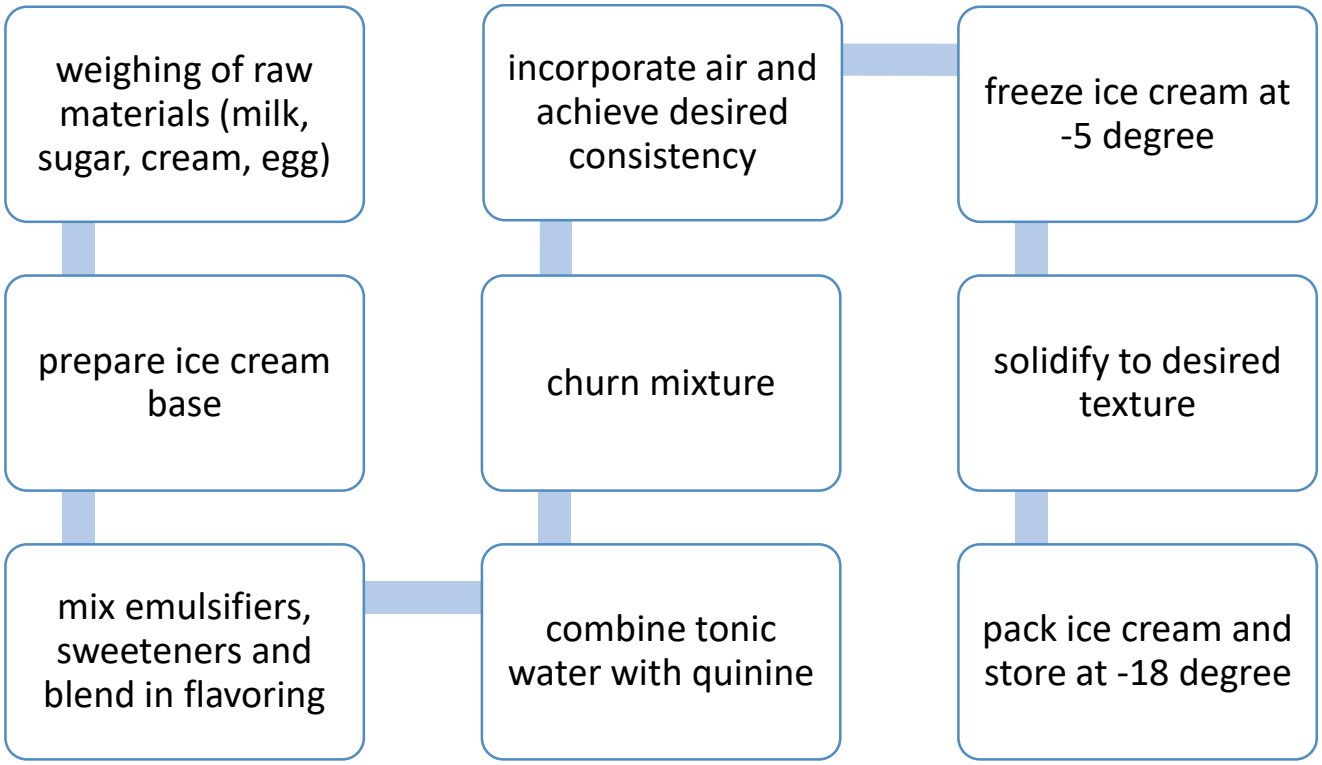
Material

Gather the ingredients from market that include:

Dairy products, sweeteners, flavorings, tonic water, air, emulsifiers

Product Development

The steps of developing glow in the dark ice cream are:



RESULT AND DISCUSSION

Proximate Analysis of Ice Cream

This section summarizes the experimental outcomes, focusing on how quinine influenced both the fluorescent qualities and the physical and nutritional properties of the ice cream. Proximate analysis was conducted based on AOAC methods.

Parameter	Methodology	Result
Moisture Content	Vacuum oven at 60°C	43.75%
Ash Content	Incinerated at 600°C for 2 hours in a muffle furnace	1.00%
Crude Protein	Determined by Kjeldhal method	0.71%
Crude Fat	Determined by ether extraction method	15.90%
Carbohydrate	Calculated by difference (100 – sum of other components)	38.64%
Energy Content	Calculated by adding calories	292.40%

Effect of Quinine on Physical Properties

Total solids are a key factor affecting ice cream quality; high solids create a curdled texture, while low solids lead to a coarser texture, as even small changes in solids can significantly impact ice crystal formation. The pH of the ice cream sample was nearly neutral, around 6.9. With a density of 0.75 g/cm³, the overrun was approximately 70–80%, meaning the ice cream contains about 50% air by volume—providing an ideal balance of creaminess and lightness. However, increased density is generally undesirable, as it can negatively impact the consistency and smoothness of the final product. The viscosity, measured at 2256.5 cP, is relatively high for ice cream with quinine, but can enhance thickness and creaminess in some formulations. This increased viscosity also slows gas diffusion between bubbles, delaying coalescence and improving texture stability.

Ice Cream Overrun Characteristic

For quinine ice cream, an overrun of 60% and a density of 0.75 g/cm³—a common commercial density—suggest a good balance of lightness and creaminess. However, the high viscosity makes the product feel heavier and denser than expected, reducing the perceived air volume and effectively lowering the overrun.

Melt Down Characteristic

Quinine ice cream likely melts more slowly, around 10 minutes, due to its higher viscosity and reduced overrun. The dense texture, with minimal air, reduces surface area for heat exchange, slowing melt time.

Texture Analysis

The density (0.75 g/cm³) and high viscosity (2256.6 cP) of quinine ice cream give it a creamy, smooth texture by trapping air efficiently. Even quinine distribution prevents any grittiness, while increased density and viscosity enhance firmness, ideal for scooping and premium quality.

Testings	Instrument	Results
Density	A fixed volume of ice cream was weighed and density was determined according to Eq. Density(g/cm3)= *icecream weight/sample weight*	0.75g/cm3
Viscosity	Determined at 20 °C using a rotational viscometer at 180 rpm.	2256.5 ± 33.8cp
pH	Measured using a pH meter	6.9
Overrun	Measured by the Eq. Overrun % = *w1-w2/w2 *100*	60.75 ± 1.71[b]
Meltdown Test	Evaluated using a screen-dip test	Structure was maintained for 10mins
Texture Analysis	Texture analysis of ice cream was performed at room temperature (22 °C) using a Texture Analyzer	64.6 ± 17.3

CONCLUSION

This study effectively examined the integration of quinine into ice cream, assessing its impact on fluorescence, texture, and quality. Nutritional analysis showed that quinine ice cream had 43.75% moisture, 1.00% ash, 0.71% protein, 15.90% fat, 38.64% carbohydrates, an energy content of 292.40 kcal/100g, and an overrun of 76.66%. Rheological tests confirmed the power-law model aptly described its flow behavior, highlighting protein's role in boosting viscosity and emulsion stability. Quinine-enriched ice cream displayed higher hardness and consistency than conventional ice cream, though adjustments brought it closer to traditional textures. The meltdown test revealed two unique behaviors—complete drip-through and remnant foam—each with distinct height reduction patterns over time, offering insights into texture and stability essential for quality and appeal. The innovative addition of quinine reflects a trend toward novelty, enhancing the visual appeal of food through its UV-induced glow. This unique effect not only meets the demand for eye-catching foods but also aligns with growing interest in interactive dining. As consumers increasingly seek novel experiences, this blend of science and culinary art may inspire further creative food products. Leveraging sensory features like fluorescence and incorporating ingredients with health benefits, such as quinine, could broaden the appeal of such foods, merging taste, health, and aesthetic appeal.

Overall, the successful inclusion of quinine in ice cream could pave the way for further culinary experimentation, encouraging trends toward visually dynamic, engaging, and health-conscious food innovations.

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