

Vegetable-Based Milk Alternatives: A Sensory Study of Potato Milk and Pea Milk

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Abstract: This study evaluates plant-based milks as sustainable alternatives to dairy, focusing on their sources, health benefits and sensory attributes. The functional characteristics of selected plant-based milks, including viscosity and bulk density were assessed to determine their suitability for food applications. Emerging alternatives such as potato milk and pea milk were highlighted for their nutritional potential, allergen-free nature and environmental sustainability. Potato milk produced by blending cooked potatoes with water requires fewer natural resources. And it is free from lactose, gluten, soy and nuts. Pea milk derived from cooked split peas is rich in plant-based protein, low in sugar when unsweetened and supports satiety, muscle repair and digestive tolerance. Overall, the favourable sensory and environmental attributes of plant-based milks indicate strong consumer acceptability and potential for wider incorporation into sustainable food systems.

Keywords: Plant-Based Milk, Dairy Alternatives, Potato Milk, Pea Milk.

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I. INTRODUCTION

Plant-based milk is a dairy alternative made from plant-based sources such as nuts, seeds, grains or legumes. Some of the most popular plant-based milks include soy milk, almond milk, coconut milk and oat milk. Plant-based milk has become a major substitute for traditional dairy milk. In recent years due to shifting consumer tastes, health consciousness, lactose intolerance, moral considerations and environmental sustainability. A liquid extract derived from plant sources, including nuts, seeds, grains, legumes and other plant materials is known as plant-based milk, sometimes called non-dairy or alternative milk (Pula, A. A. et al., 2020). These drinks are designed to meet a variety of dietary requirements and lifestyles while having a look, feel and functionality similar to cow's milk. The demand for plant-based milk has increased globally due to the quick rise in veganism, flexitarian diets, and food allergy awareness (Mäkinen, O. E., Wanhalinna, V., Zannini, E., & Arendt, E. K., 2016).

Plant-based milk is made from a wide range of raw materials, which adds to its diversity in flavour, texture, and nutritional make-up. Nuts like almonds, cashews, and hazelnuts;

seeds like hemp, flax, chia, and sesame; grains like rice, quinoa, and oats; legumes like soybeans and peanuts; coconuts; and new sources like potatoes and peas are examples of common sources (Chalupa-Krebsbach, S., 2018). Because each source has distinct functional and nutritional qualities, manufacturers are able to customize products for particular consumer groups, such as infants, athletes, people with food allergies, and those who are lactose intolerant. Because of this variety, plant-based milk is now used in a wider range of products than just drinks such as yogurt substitutes, cheese substitutes, ice creams, creamers, baked goods, sauces, soups and dietary supplements (Sethi, S., Tyagi, S. K., & Anurag, R. K., 2016).

Depending on the source material and degree of fortification, plant-based milk shows significant variation in terms of nutrition. Naturally, milks made from nuts and seeds offer healthy unsaturated fats, and some types also include bioactive compounds and dietary fibre. The amount of protein in milk varies greatly. Soy and pea milk have comparatively more protein than rice or almond milk. Many commercial plant-based milks are fortified with calcium, vitamin D, vitamin B12, and other micronutrients to improve nutritional adequacy and match cow's milk. However, when choosing

appropriate substitutes variations in calorie content, macronutrient balance and micronutrient availability continue to be crucial factors (Jeske, E. K., Zannini, E., & Arendt, E. K., 2017).

A number of standardized processing procedures such as raw material selection, cleaning, soaking, grinding, extraction, filtration, formulation, pasteurization or homogenization, packaging and quality control are involved in the production of plant-based milk. These procedures are essential for guaranteeing nutritional consistency, safety, shelf life and sensory acceptability. Product stability, mouthfeel and consumer acceptability are all impacted by physicochemical characteristics like pH, specific gravity and viscosity. Almond, soy, coconut, oat and rice milk all have very different sensory qualities, such as taste, aroma, and texture, which influence consumer preference and commercial success (Tanguy, M., Muller, J., Bolten, C. J., & Wittmann, C., 2019).

Although plant-based milk has many health advantages, including being lactose-free, having less saturated fat, being hypoallergenic and being eco-friendly, there are drawbacks. Potential issues include the possibility of adulteration, the presence of additives or sweeteners, lower protein content in some varieties and nutrient deficiencies without adequate fortification. Therefore, it is crucial for consumers, nutritionists, and food technologists to comprehend the sources, nutritional value, processing techniques, health advantages and limitations of plant-based milk. This study focusses on new substitutes like potato and pea milk, emphasizing their nutritional value and contribution to sustainable food systems (Casey, C. E., & Hambidge, K. M., 2007).

II. MATERIALS AND METHODS

➤ Procurement of Samples:

Potatoes (*Solanum tuberosum*), Dried green peas (*Pisum sativum*) were procured from a local store in Vijayawada, Andhra Pradesh, India. The samples were purchased in sealed packs to ensure quality under ambient conditions until analysis. All experiments were conducted under hygienic conditions.

➤ Preparation of Vegetable-Based Milk:

• Potato Milk:

Potato milk was prepared by the conventional method. Potatoes were washed, peeled and cut into small pieces. They were boiled until tender and cooled before blending to a smooth paste using water. The resultant mixture is filtered through a mesh strainer to remove pulp. The smooth liquid obtained was used for experimentation.

• Pea Milk:

Pea milk was prepared by the conventional method. Peas were washed and soaked overnight. They were pressure cooked and cooled before blending to a smooth paste using water. The resultant mixture is filtered through a mesh strainer to remove pulp. The smooth liquid obtained was used for experimentation.

➤ Functional Properties:

• Specific Gravity:

Specific gravity of the potato and pea milk was measured using a hydrometer (G. Zobel, 2020)

• Viscometer Test:

Viscosity is the property of a fluid that describes its resistance to flow. Depending on the internal friction between a liquid's molecules during motion, it shows how thick or thin the liquid is (Ostwald, W., & The Chairman 1913).

$$\eta = \eta_0 \times \frac{\rho_0 t_0}{\rho t}$$

• Ph Range:

pH is a measure of the acidity of an aqueous solution, widely used in scientific and industrial applications. It is associated with the activity of hydrogen ions in solution, which indicates the degree of acidity (Mesmer, R.E., Holmes, H.F., 1992).

$$pH = -\log_{10}[H^+]$$

➤ Sensory Properties:

Firstly, to determine a product's quality, it's based on appearance, which includes visual cues including colour, size, form, surface texture, and glossiness. Expectations regarding doneness, freshness, and general acceptability are influenced by these factors. The term "aroma" describes the volatile substances in food that are detected by olfactory receptors during eating, either retro nasally or through the nose. Aromas can be detected separately from taste and are important factors that determine flavour. Taste is the oral perception of soluble substances, such as sweet, sour, salty, bitter, and umami, that arouse taste buds. The overall perception of flavour is formed by the interactions between these fundamental tastes and aromas. The tactile and kinaesthetic sensations—such as moisture, oiliness, dryness, and coating—that are felt in the mouth during chewing and swallowing are referred to as mouthfeel (Setser, C. S., 1993).

III. RESULTS AND DISCUSSION

➤ Hydrometer Test:

The relative density was 1.02 ± 0.002 for potato milk and 1.0103 ± 0.003 for pea milk (Table 1). Compared to pea milk, potato milk has a slightly higher relative density, which suggests a higher concentration of total soluble and suspended solids. This implies that potato milk has more body and thickness, which could improve mouthfeel in food applications. Pea milk, on the other hand, has a comparatively lighter composition with fewer dissolved solids, which accounts for its lower density. The two vegetable-based milk substitutes have different physicochemical properties, which are generally highlighted by relative density differences.

➤ Viscometer Test:

Viscosity measurements obtained using a viscometer showed a clear difference between pea milk and potato milk. Pea milk exhibited a lower viscosity with a flow time of 3 min

52 sec and a standard deviation of approximately (± 2.0 cP), indicating a relatively lighter body and smoother flow characteristics (Table 1). This lower viscosity suggests its suitability for beverage-type applications requiring easy pourability. In contrast, potato milk recorded a higher flow time of 7 min 50 sec with a standard deviation of approximately (± 4.0 cP), reflecting a thicker consistency and greater resistance to flow. The higher viscosity of potato milk can be attributed to its starch-rich composition, which promotes increased thickening. The low standard deviation values indicate consistent and reproducible viscosity measurements for both samples.

➤ *pH Range:*

Pea milk and potato milk had pH values of 6.0 ± 0.02 , which indicates near-neutral acidity (Table 1). Because it reduces the possibility of curdling during heating and cooking, thus this pH range is appropriate for culinary applications. The two vegetable-based milks appear to have similar acid-base properties based on their similar pH values. Additionally, a pH that is almost neutral enhances sensory acceptability and mild

flavour perception. The analysis's accuracy and dependability are demonstrated by the low standard deviation, which shows little variation between replicate measurements. The stability and adaptability of both potato milk and pea milk in food preparations are generally supported by the pH characteristics.

➤ *Sensory Evaluation:*

Organoleptic and sensory characteristics of the samples were evaluated using soups prepared from potato milk and pea milk (Fig 1). The potato milk soup exhibited a white colour, thick consistency, and a mildly sweet, potato-like flavour, indicating good body and enhanced mouthfeel. Its thicker texture contributed to a creamy perception, making it suitable for soup-based applications. In contrast, the pea milk soup showed a light green colour with a characteristic pea flavour and a mildly thick consistency. The flavour and appearance of pea milk soup were considered acceptable and pleasant by sensory evaluation. Overall, potato milk demonstrated greater body and thickness, whereas pea milk exhibited satisfactory sensory quality with a lighter texture and distinct flavour profile.

Table 1 Functional Properties of Potato and Pea Milk

Functional Properties	Potato Milk	Pea Milk
Hydrometer	(1.02 ± 0.002)	(1.0103 ± 0.003)
Viscometer	7 Min 50 Sec(±4.0 Cp)	3 Min 52 Sec(±2.0 Cp),
pH	6.0 ± 0.02	6.0 ± 0.02

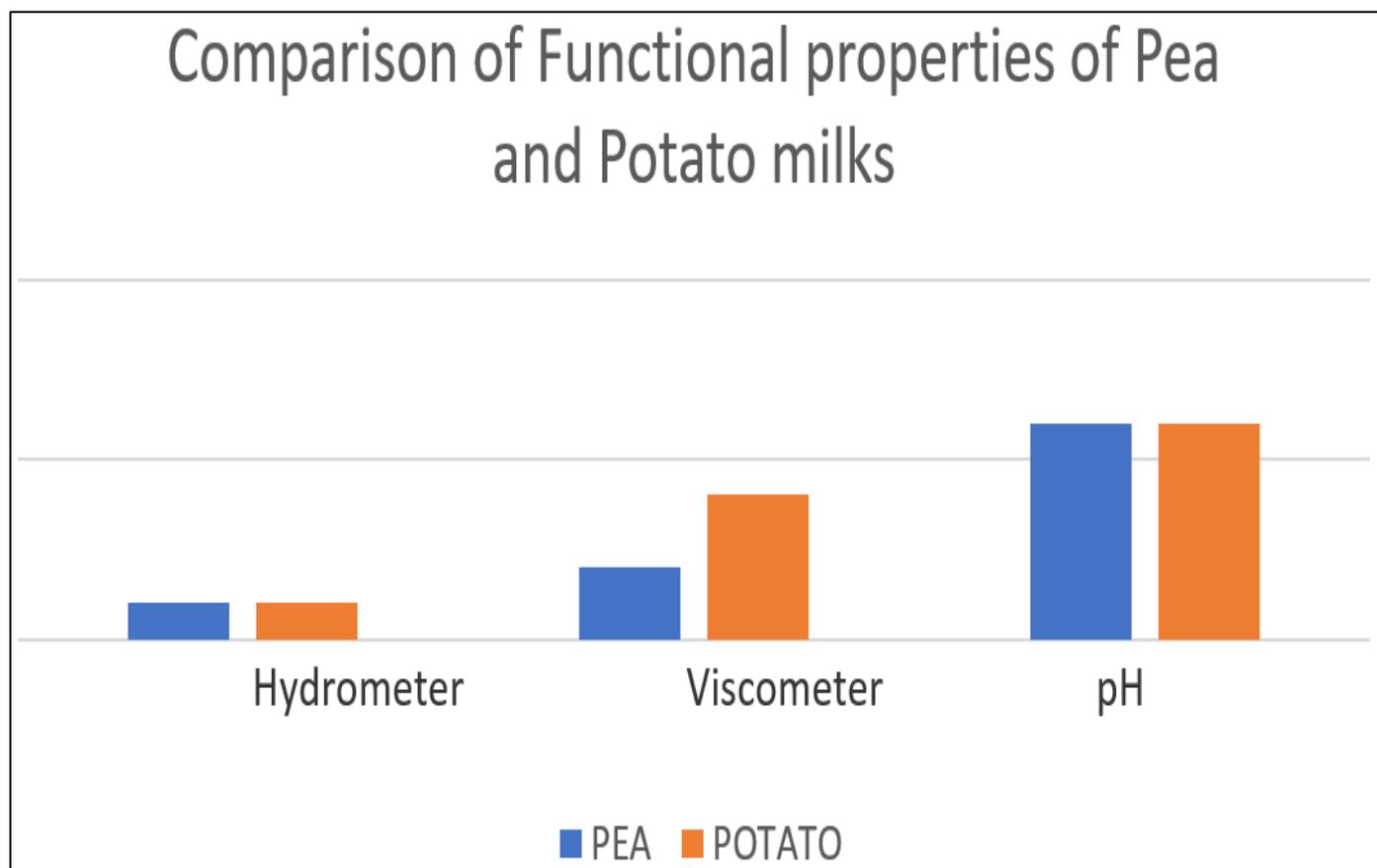


Fig 1 Graphical Representation of Functional Properties of Plant Based Milks

IV. CONCLUSION

According to the current study, pea milk and potato milk have different physicochemical and sensory characteristics that make them appropriate for a variety of food applications. Potato milk is especially well-suited for soups, sauces, and thick-consistency formulations because of its higher relative density and viscosity, which contribute to greater body, thickness, and mouthfeel. Pea milk is useful for beverage-type products and applications that need easy pourability because of its lighter texture and reduced viscosity. Both milks demonstrated acceptable sensory qualities and a pH that was almost neutral, which supported their stability and culinary adaptability. All things considered, these results demonstrate the potential of potato and pea milk as sustainable, non-allergic and useful vegetable-based milk substitutes for creative and health-conscious food product development.

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