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Development and Sensory Acceptance of Avocado Paste with Potential Application in a Ketogenic Diet

Desenvolvimento e Aceitação Sensorial de Pasta de Abacate com Potencial para uso em Dieta Cetogênica

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Abstract

The ketogenic diet is a nutritional strategy based on high fat intake and low carbohydrate intake. Avocado stands out as a promising ingredient for this dietary approach due to its high lipid content and the presence of bioactive compounds. However, the high perishability of avocado fruit necessitates the use of technological solutions to prolong its usability. In this context, the development of avocado-based pastes represents a viable and functional alternative. This study aimed to develop and evaluate, through sensory analysis, two avocado paste formulations with potential application in the ketogenic diet. Two formulations were developed: F1 (avocado, coconut milk, coconut oil, and erythritol) and F2 (identical base composition with the addition of cocoa). Sensory analyses were performed by 75 untrained adult assessors, employing an acceptance test (9-point hedonic scale), purchase intention test (5-point scale), and paired preference test. Both formulations achieved high acceptance rates (92% for F1 and 90.6% for F2), accompanied by low rejection. Purchase intention results were also positive, with 80% of evaluators indicating that they would purchase F1 and 85.4% indicating purchase intent for F2. In the paired preference test, 69% of participants preferred formulation F2, indicating that the addition of cocoa enhanced sensory characteristics. Furthermore, the cocoa-containing formulation aligns with current dietary recommendations advocating the consumption of foods rich in bioactive compounds, such as those present in cocoa. Thus, the avocado pastes developed exhibited favorable sensory acceptance and demonstrated promising market potential as functional products suitable for the ketogenic diet. The cocoa-containing formulation (F2) was notably preferred by participants.

Keywords: Avocado. Ketogenic Diet. Sensory Analysis. Cocoa.

Resumo

A dieta cetogênica é uma estratégia nutricional baseada na alta ingestão de gorduras e baixa ingestão de carboidratos. O abacate destaca-se como ingrediente promissor para essa dieta por seu elevado teor lipídico e compostos bioativos. Contudo, sua perecibilidade exige alternativas tecnológicas. Nesse contexto, o desenvolvimento de pastas de abacate surge como proposta viável e funcional. O presente estudo teve como objetivo desenvolver e avaliar sensorialmente duas formulações de pasta de abacate com potencial aplicação na dieta cetogênica. Foram elaboradas duas formulações: F1 (abacate, leite de coco, óleo de coco e eritritol) e F2 (mesma base com adição de cacau). As análises sensoriais incluíram teste de aceitação (escala hedônica de 9 pontos), intenção de compra (escala de 5 pontos) e teste de pareado de preferência, aplicados a 75 assessores adultos não treinados. Ambas as formulações apresentaram elevados índices de aceitação (92% para F1 e 90,6% para F2), com baixa rejeição. A intenção de compra também foi positiva, sendo que 80% dos avaliadores afirmaram que comprariam a F1 e 85,4% a F2. No teste de preferência, 69% dos participantes optaram pela F2, sugerindo que a adição de cacau contribuiu para a melhoria das características sensoriais. A formulação com cacau também se alinha às recomendações de consumo de alimentos com compostos bioativos, como os presentes no cacau. Assim, as pastas desenvolvidas demonstraram boa aceitação sensorial e potencial de mercado como produtos voltados para a dieta cetogênica. A formulação com cacau (F2) destacou-se, evidenciando-se como a formulação com maior preferência sensorial.

Palavras-chave: Abacate. Dieta Cetogênica. Análise Sensorial. Cacau.

1 Introduction

The ketogenic diet (KD) is a dietary therapeutic strategy employed primarily for controlling epileptic seizures. It is characterized by a high-fat, adequate-protein, and low-carbohydrate nutritional composition, inducing a metabolic state known as ketosis. Various adaptations of the ketogenic diet have been developed to enhance adherence, palatability, and treatment tolerability. These adaptations include the Classic Ketogenic Diet, the Medium Chain Triglyceride (MCT)-based Diet, the Modified Atkins Diet, and the Low Glycemic Index approach (Wells *et al*., 2020).

This dietary regimen predominantly includes foods rich in fats, such as cream, bacon, mayonnaise, and various oils, along with protein-rich items such as meats, eggs, and cheeses. Carbohydrate intake is restricted, typically derived from limited quantities of fruits, vegetables, and leafy greens (Sampaio, 2018).

Avocado (*Persea americana* Mill.) stands out due to its favorable nutritional profile. It possesses a high lipid content ranging from 5% to 31%, predominantly comprising monounsaturated fatty acids, notably oleic acid (omega-9). Additionally, avocado is an important source of phytosterols, carotenoids, dietary fiber, and other bioactive compounds capable of modulating metabolic processes (Bissole; Barcello, 2018).

However, tropical fruits such as avocado are highly perishable, limiting their shelf life when

consumed fresh. As a technological solution to overcome this limitation, processing fruits into various products, including juices, jams, jellies, pulps, and purées, is widely practiced to facilitate year-round consumption (Caetano; Daiuto; Vieites, 2012). According to the Technical Regulation of the Brazilian Health Regulatory Agency (Anvisa, RDC 272/05), fruit-derived products may undergo technological processes such as drying, dehydration, cooking, and freezing. These processes must guarantee the safety of the final product and preserve its nutritional attributes.

Ramos (2018) developed an avocado paste containing sugar, cocoa, soy lecithin, and citric acid. This product demonstrated shelf-life viability through the application of irradiation technology, in addition to showing probiotic potential and commercial feasibility.

According to Daiuto *et al*. (2014), avocado possesses excellent nutritional characteristics and yields a substantial quantity of pulp, making it a viable raw material for new food product development. Their studies resulted in an avocado paste that maintained appropriate sensory characteristics even after prolonged storage.

Consequently, avocado emerges as a promising ingredient for the development of processed products, such as pastes, which may offer improved stability and extended shelf life. Given these considerations, this study aimed to develop and sensorially evaluate avocado paste formulations with potential applicability in the ketogenic diet.

2 Material and Methods

Product preparation and sensory analyses were conducted at the Dietetic Techniques Laboratory of Maurício de Nassau University Center, located in Teresina, Piauí, Brazil.

Avocados (*Persea americana* Mill.) utilized in the preparation of the products were obtained from the Piauí Supply Center (Ceasa). The fruits were acquired at the physiological ripening stage, characterized by a dark green peel color and slight softness upon tactile evaluation. Subsequently, the fruits were transported to the laboratory for appropriate sanitization and storage. Additional ingredients included coconut milk, coconut oil, cocoa, erythritol, and citric acid, all purchased from local suppliers in Teresina.

Two avocado-based paste formulations were prepared: formulation F1, containing avocado, coconut oil, coconut milk, and erythritol; and formulation F2, composed of the same base ingredients with the addition of cocoa. The paste preparation began by grinding the avocado pulp along with citric acid in a food processor for five minutes. Subsequently, the remaining ingredients were

incorporated into the mixture. All utensils and equipment used in the process were properly sanitized prior to use, following the methodology adapted from Ramos (2018).

Sensory acceptance of the two formulations was assessed using a 9-point hedonic scale, anchored at the extremes by "I disliked it very much" (score 1) and "I liked it very much" (score 9). Purchase intention was evaluated through a 5-point scale, ranging from "would definitely not buy" (score 1) to "would definitely buy" (score 5). Additionally, a paired preference test was conducted to identify the preferred sample between the two formulations.

These sensory tests were performed by 75 untrained adult assessors, both male and female, aged between 20 and 50 years. All sensory analyses were carried out according to the procedures described by Dutcosky (2019).

This study was approved by the Research Ethics Committee of the Federal University of Piauí (approval number 7,172,228). Before conducting the tests, all assessors participating in the sensory evaluation were informed about the objectives and methodology of the research and provided written informed consent by signing an Informed Consent Form (ICF).

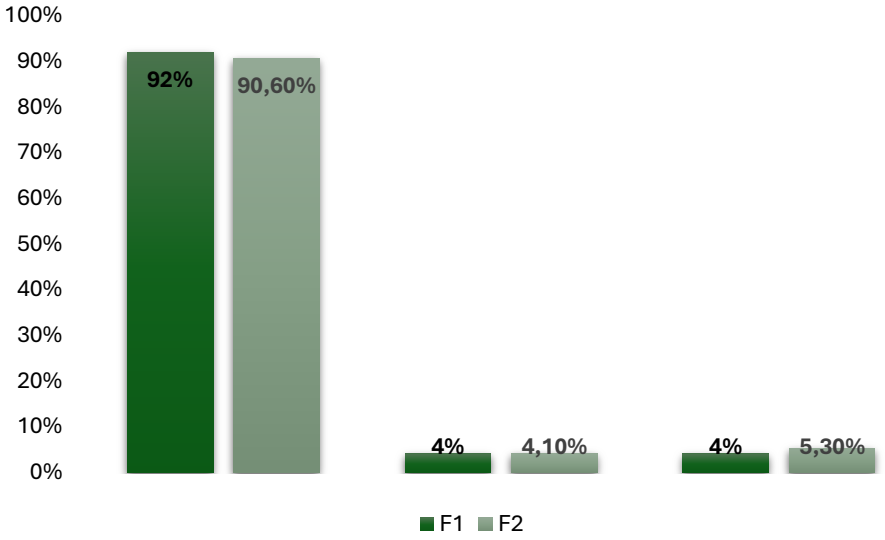
3 Results and Discussion

Sensory evaluation is a crucial stage in the development of new products, particularly for diets with specific nutritional restrictions, such as the ketogenic diet. This study presents the sensory acceptance results related to global impression using a hedonic scale, purchase intention, and sensory preference between two avocado paste formulations: F1 (avocado paste containing coconut milk and coconut oil) and F2 (avocado paste containing coconut milk, coconut oil, and cocoa).

Figure 1 demonstrates that both formulations presented high acceptance rates, reaching 92% for F1 and 90.6% for F2, accompanied by minimal rejection rates (4% and 5.3%, respectively). These results indicate strong sensory acceptance of both formulations, suggesting their potential for successful consumer adoption. These findings align with those reported by Ramos *et al.* (2020), who similarly observed good sensory acceptance using hedonic scales for avocado-based functional pastes, both with and without added cocoa.

The observed acceptance rates highlight that the avocado pastes, irrespective of the formulation, were consistently well-accepted, surpassing 70% acceptance. Additionally, the low percentage observed in the "indifferent" category suggests that both formulations exhibited clearly defined sensory attributes.

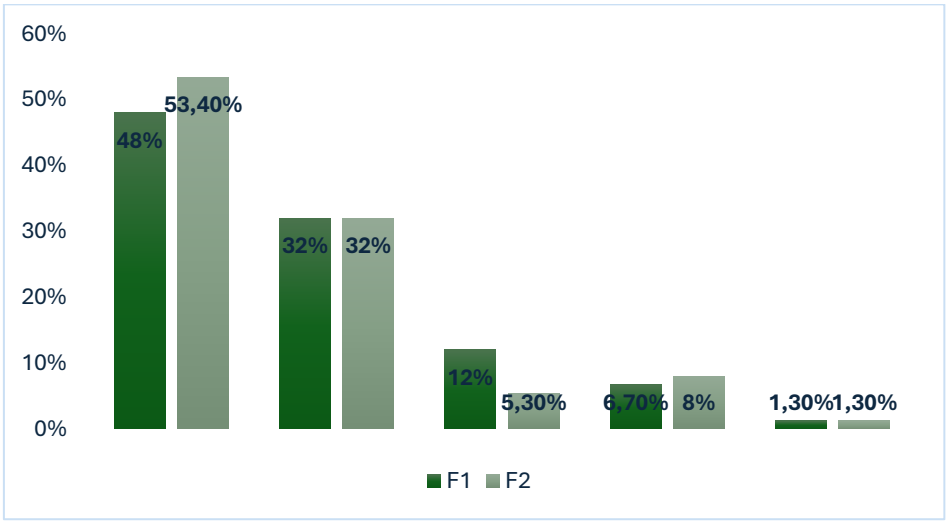
Figure 1 - Acceptance, indifference, and rejection rates for two avocado paste formulations



First Bar Acceptance: (scores 9 - 6); Second Bar Indifference (score 5); Third BarRejection: (scores 4 - 1). Source: Research Data. Teresina-PI, 2025. F1 (avocado cream formulation with coconut milk and coconut oil). F2 (avocado cream formulation with coconut milk, coconut oil, and cocoa).
Source: research data.

Purchase intention data for these products are presented in Figure 2. According to this test, both products also exhibited high acceptability regarding purchase intent. Formulation F2 displayed a slightly higher percentage in the "would definitely buy" category (53.4%) compared to F1 (48%), suggesting greater market attractiveness for the cocoa-containing version.

Figure 2 - Purchase intention for two avocado paste formulations



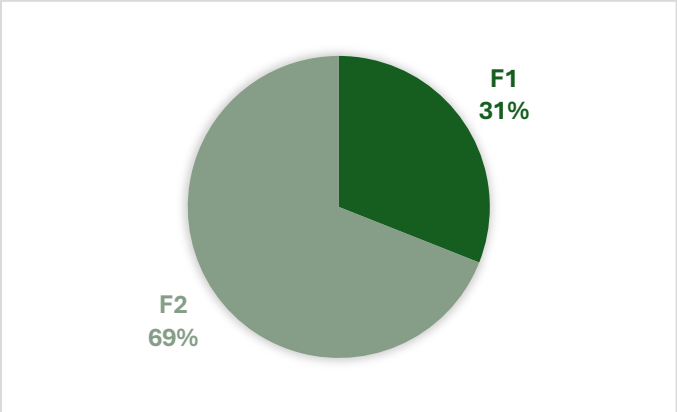
First bar: would definitely buy; Second Bar: would probably buy; Third bar: neutral; Fourth bar: would probably not buy end Fifth bar: definitely not buy. Source: Research Data. Teresina-PI, 2025. F1 (avocado cream formulation with coconut milk and coconut oil). F2 (avocado cream formulation with coconut milk, coconut oil, and cocoa).
Source: research data.

The results of the purchase intention test corroborate those obtained in the sensory acceptance evaluation (Figure 1), highlighting a considerable predisposition among the evaluators to purchase the developed products. Over 70% of participants indicated positive purchase intention, with 80% stating they would or probably purchase formulation F1, whereas 85.4% expressed similar intentions towards formulation F2 (Figure 2).

A comparative analysis of results obtained from the hedonic scale and purchase intention tests revealed that formulation F1 exhibited slightly higher sensory acceptance. Conversely, formulation F2 showed a higher purchase intention and was the preferred formulation among most participants. This discrepancy might be attributable to consumers' cultural and emotional affinity towards chocolate, contributing to higher commercial appeal for formulation F2, despite its marginally lower initial sensory acceptance.

Paz *et al*. (2022) reported that chocolate, which possesses desirable sensory properties, is also a significant source of nutrients, including proteins, lipids, calcium, magnesium, iron, zinc, and vitamins. Furthermore, cocoa enhances sensory attributes through its characteristic color, aroma, and flavor, which are broadly appreciated by various demographic groups. These attributes likely positively influenced consumer perception, thereby increasing purchasing propensity (Figure 3).

Figure 3 - Sensory preference distribution between the two avocado paste formulations



Teresina-PI, 2025. F1 (avocado cream formulation with coconut milk and coconut oil). F2 (avocado cream formulation with coconut milk, coconut oil, and cocoa).
Source: research data.

Regarding sensory preference (Figure 3), 69% of participants preferred formulation F2, whereas 31% preferred formulation F1. These data reinforce the role of cocoa as a notable sensory differentiator, contributing significantly to the hedonic acceptance of the product.

In their study examining the functional benefits of cocoa and its derivatives, Ribas, Gonçalves, and Mazur (2018) described multiple positive health effects associated with cocoa consumption,

primarily attributed to its phenolic compounds. The authors emphasized the importance of incorporating cocoa and its derivatives into a balanced diet, particularly through minimally processed forms containing reduced levels of added sugars and food additives. Therefore, formulation F2, developed as an avocado paste containing cocoa, presents an alternative product compatible with these dietary recommendations.

Avocado proved to be a sensorially promising lipid base for the development of novel food products. The growing demand for diverse and high-quality products suitable for restrictive diets (Martins *et al*., 2021), combined with an increasing consumer interest in ready-to-eat products (Arévalo-Pinedo, 2010), underscores the necessity for technologies ensuring practicality without compromising sensory quality.

Thus, the results of this study regarding sensory acceptance and preference for the avocado paste formulations demonstrate the feasibility of introducing this type of product to the market, effectively combining functionality, convenience, and positive consumer acceptance.

4 Conclusion

The developed avocado paste formulations exhibited high sensory acceptance, minimal rejection, and strong purchase intention. Considering its nutritional profile rich in unsaturated fats and naturally creamy texture, avocado represents a viable and promising lipid base for developing food products targeted towards the ketogenic diet. Additionally, cocoa demonstrates considerable potential as a functional ingredient capable of enhancing the product's sensory attributes.

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