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The nutritional breakthrough: B vitamins in gelatinized cucumber for diabetic spread

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Abstract

The rising prevalence of diabetes worldwide necessitates the development of innovative functional foods to support glycemic control and overall health. This study explores a novel approach to enhancing the nutritional profile of diabetic-friendly spreads by incorporating B vitamins into gelatinized cucumber formulations. Cucumbers, known for their high-water content and low glycemic index, serve as a natural base for this product. The process of gelatinization improves the texture and stability of the spread while enhancing the bioavailability of added nutrients. Fortification with B vitamins, particularly B6, B9 (folate), and B12, addresses common deficiencies in diabetic populations, contributing to improved energy metabolism, neurological health, and cardiovascular support.

The study evaluates the physicochemical properties, nutrient retention, and consumer acceptability of the fortified spread, alongside its potential impact on glycemic response. Preliminary results demonstrate that gelatinized cucumber enriched with B vitamins offers a promising functional food alternative for individuals managing diabetes, providing both nutritional and sensory benefits. This innovation underscores the potential of leveraging natural food matrices to deliver targeted health benefits, paving the way for new advancements in diabetic nutrition.

Keywords: Diabetes, spread, cucumber, vitamin-B, glycemic index

1. Introduction

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia due to insulin deficiency or resistance. Effective dietary management is critical for preventing complications associated with diabetes. Functional foods—products developed to provide additional health benefits beyond basic nutrition—have emerged as potential dietary tools in diabetes management. Among such innovations, cucumber-based spreads fortified with B vitamins hold promise for addressing common nutritional deficiencies while maintaining low glycemic impact. Cucumbers (*Cucumis sativus*) are predominantly composed of water, with a minimal impact on blood glucose levels, making them an excellent candidate for diabetic-friendly food products.

Cucumbers, a creeping vine plant belonging to the Cucurbitaceae family, are widely cultivated. Cucumber is a widely cultivated plant in the gourd family, Cucurbitaceae.

Cucumbers are rich in phytonutrients, which are plant-based nutrients that offer various health benefits. They contain flavonoids, triterpenes, and lignans, which are antioxidants with anti-inflammatory properties and the potential to combat cancer. Cucumbers also help maintain blood pressure, regulate hydration, control blood sugar, soothe the skin, aid in digestion, and support weight loss by reducing fat. Cucumber spread is a refreshing appetizer or snack, particularly suitable for individuals with kidney disease due to its low sodium, potassium, and phosphorus content. Cucumbers are hydrating, provide dietary fiber for regularity and avoiding constipation, and contain vitamin K for blood clotting and bone health. Additionally, they offer vitamin A, which plays roles in vision, the immune system, and reproduction, all while being low in calories (Balasundram *et al.*, 2006) [1]. Gelatinization enhances the texture and stability of cucumber-based formulations, while fortification with B vitamins contributes to addressing deficiencies linked to diabetes, such as those in B6, B9 (folate), and B12. These vitamins play vital roles in energy metabolism, neurological health,

and cardiovascular function—all critical for individuals managing diabetes. (Trumbo *et al.* 2001)^[3]

This paper explores the formulation and evaluation of a gelatinized cucumber spread fortified with B vitamins. The study assesses its nutritional composition, physicochemical properties, consumer acceptability, and potential glycemic benefits, aiming to establish its role as a functional food for diabetes management.

2. Materials and Methods

2.1 Raw Materials

Fresh cucumbers were procured from local markets and selected based on uniform size, maturity, and absence of defects. Commercial-grade gelatin and B vitamin supplements (B6, B9, B12) were sourced from Food chem International corporation. Additional ingredients, such as natural stabilizers and flavor enhancers, were used to optimize the formulation.

2.2 Preparation of Gelatinized Cucumber Spread

The cucumbers were washed, peeled, and blended into a puree. Gelatin was dissolved in water at 60°C and added to the cucumber puree. B vitamins were incorporated at concentrations aligning with recommended dietary allowances for adults. The mixture was homogenized and cooled to form a stable gel-like spread.

2.3 Physicochemical Analysis

The pH, viscosity, and water activity (Aw) of the spread were measured using standard protocols. Nutrient composition was analyzed to quantify the levels of B vitamins before and after processing, ensuring retention and stability.

2.4 Sensory Evaluation

A sensory panel comprising 30 participants evaluated the spread based on texture, flavor, aroma, and overall acceptability using a 9-point hedonic scale.

2.5 Glycemic Response Study

A randomized, crossover study was conducted involving 20 diabetic individuals. Participants consumed the cucumber spread alongside a standard carbohydrate meal, and their postprandial blood glucose levels were monitored over two hours.

2.6 Statistical Analysis

Data were analyzed using SPSS software, with significance set at $p < 0.05$. Descriptive statistics, ANOVA, and paired t-tests were applied to interpret the results.

3. Results and Discussion

Gelatinized cucumber provides a nutrient-dense option with a low-calorie profile, ideal for diabetic individuals. The moderate fiber content aids in glycemic control by slowing sugar absorption. Additionally, the enhanced presence of B vitamins, especially Vitamin B6, supports better energy metabolism and nerve health. The fortified cucumber spread provided significant amounts of B6 (0.15mg/100 g), B9 (9 µg/100 g) meeting a substantial percentage of daily requirements. The gelatinization process did not significantly degrade the vitamins, demonstrating the formulation's stability (Prasad, M. P., Tyagi, R., 2020)^[4].

Table 1: Nutritional Composition of Gelatinized Cucumber

Nutrient	Quantity per 100 g	% Daily Value (Based on 2000 kcal diet)
Energy	30 kcal	1%
Carbohydrates	7.0 g	2%
Proteins	1.2 g	2%
Fats	0.2 g	<1%
Fiber	0.8 g	3%
VitaminB1 (Thiamine)	0.05 mg	4%
Vitamin B2 (Riboflavin)	0.04 mg	3%
Vitamin B3 (Niacin)	0.3 mg	2%
Vitamin B6	0.15 mg	9%
Folate (B9)	9 µg	3%

The process of gelatinization significantly enhances the bioavailability of B vitamins in cucumber. This increase is most notable in Riboflavin (Vitamin B2) and Folate (Vitamin B9), making gelatinized cucumber a superior choice for those requiring higher vitamin intake. These improvements suggest that the process breaks down cellular walls, improving nutrient accessibility.

Table 2: Comparison of B Vitamin Levels in Gelatinized vs. Raw Cucumber

Nutrient	Raw Cucumber (per 100 g)	Gelatinized Cucumber (per 100 g)	% Increase
VitaminB1 (Thiamine)	0.015±0.01 mg	0.042±0.02 mg	140%
VitaminB2 (Riboflavin)	0.01± 0.001 mg	0.032±0.001 mg	278%
Vitamin B3 (Niacin)	0.12±0.02 mg	0.275±0.005mg	198%
Vitamin B6	0.04 ±0.001 mg	0.13±0.004mg	195%
Folate (B9)	2.83±0.08 µg	9 ±0.15µg	225%

Each benefit provided by the enhanced B vitamins and fiber in gelatinized cucumber contributes directly to improved diabetic management. For example, Thiamine (Vitamin B1) aids in carbohydrate metabolism, while Vitamin B6 plays a critical role in nerve health, potentially alleviating symptoms of diabetic neuropathy. The fiber content further complements these benefits by moderating postprandial glucose levels.

Table 3: Potential Benefits for Diabetic Patients

Benefit	Mechanism of Action	Impact on Diabetes Management
Improved Energy Metabolism	Enhanced levels of B Vitamins (B1, B2, B3, B6)	Supports glucose utilization
Nerve Function Support	Increased Thiamine and B6 levels	May reduce neuropathy symptoms
Better Glycemic Control	Low carbohydrate and fiber-rich profile	Slows glucose absorption
Antioxidant Benefits	Presence of Folate (B9)	Reduces oxidative stress in diabetics

A serving size of 50g provides a concentrated source of essential nutrients while remaining low in calories. This makes it suitable for regular consumption by diabetics. The high contribution of Vitamin B6 per serving is particularly noteworthy, as it supports nerve function and energy metabolism. This serving size also ensures a balanced nutrient intake without exceeding caloric requirements. The

enriched cucumber spread addresses two key challenges in diabetes management: providing a low-glycemic food option and alleviating nutritional deficiencies. B vitamins, particularly B6, B9, and B12, support metabolic pathways crucial for maintaining glucose homeostasis, neurological function, and cardiovascular health. Furthermore, the product's sensory appeal ensures better compliance with dietary regimens.

Table 4: Recommended Serving Size and Nutrient Contribution
Serving Size (50g Spread)

Energy	18 kcal	Low-calorie option
Vitamin B1	6%	Boosts carbohydrate metabolism
Vitamin B2	5.5%	Supports cellular energy
Vitamin B3	4.25%	Reduces fatigue
Vitamin B6	16%	Significant nerve function aid
Folate (B9)	4%	Helps DNA synthesis

Glycaemic Response

Participants consuming the cucumber spread showed a 25% lower postprandial glucose peak compared to the control meal ($p < 0.05$). This effect is attributed to the low glycemic index of the cucumber base and the synergistic role of B vitamins in improving glucose metabolism (American Diabetes Association, 2022)^[2].

This recipe is specifically crafted for children but can be enjoyed by people of all age groups. It appeals to children who might not typically like cucumbers, as it offers a delightful taste. Consuming this spread can contribute to various health benefits, including reducing the risk of cancer and supporting the health of hair and bones. It also lowers the chances of experiencing conditions like strokes, heart attacks, and cardiovascular ailments. (Swain *et al.*, 2021)^[6]. For pregnant women, it can reduce the risk of spina bifida, neural tube defects, and anencephaly. Additionally, this spread is beneficial for individuals with digestive disorders like heartburn, gastritis, and ulcers.

Conclusion

These new products, enriched with antioxidants, have the capacity to shield cells from damage by neutralizing free radicals – the harmful molecules responsible for oxidative stress. The formulation of these food products represents a valuable addition to the realms of food product development, food technology, the food and beverage industries, and related scientific fields.

Future scope

This study aims to advocate for the inclusion of B vitamin-enriched cucumber spread in daily diets to harness the health advantages linked to dietary fibre and B-vitamins, with a specific focus on addressing diabetes and obesity management. This research holds the potential to play a pivotal role in encouraging healthier dietary preferences and potentially mitigating the risks associated with heart-related conditions and obesity. We aspire to witness its widespread adoption across the food industry, pharmaceuticals, food processing units, cosmetic industries, and the development of innovative food products in the forthcoming years.

Conflict of Interest

There is no conflict of interest between the authors in publication of this paper.

Author's Contribution

Fatema Khatun conducted the complete literature review and entire research work, Suvankar Pradhan and Poulomi Mistry generated all the figures and managed the references, and Dr. Rupali Dhara Mitra conceptualized the paper's idea and title, in addition to offering comprehensive editing for the entire manuscript.

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