

# The hypoglycemic potential of the bitter cucumber (*Momordica charantia*) exploited in the bakery industry

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**Abstract:** Bitter cucumber (*Momordica charantia*) is one of the most studied plants with antidiabetic potential, due to its high content of bioactive compounds such as charantine, polypeptide-p, vicina, triterpene saponins, flavonoids and vitamin C (70-90 mg/100 g). The literature highlights the ability of these compounds to reduce blood sugar by inhibiting  $\alpha$ -glucosidase and  $\alpha$ -amylase, stimulating glucose uptake at the cellular level and improving insulin sensitivity. In parallel, the pulp and peel of the fruit contain 2-3g/100g of dietary fiber, with beneficial effects on digestion and on reducing the glycemic load of food.

The present paper investigates the potential of the use of bitter cucumber as a functional ingredient in the bakery industry, given the need to develop hypoglycemic products and foods intended for people with diabetes, prediabetes or those following low-carb diets. In bakery applications, the addition of 2-5% powder or bitter cucumber extracts in the dough increases the hydration capacity of the dough by 8-12%, modifying the rheological properties and improving the antioxidant profile of the finished products, due to the presence of polyphenols and triterpenoids with radical-scavenging activity. However, high levels of additives can affect sensory properties, in particular by intensifying the bitter taste, which requires optimisation of proportions and processing technology.

The results synthesized from the recent literature indicate that *Momordica charantia* is a promising ingredient for the formulation of functional bakery products with hypoglycemic impact, but further research is needed on the stability of bioactive compounds during baking, the reduction of bitterness through advanced technological processes and consumer acceptability. The controlled integration of this plant raw material can contribute to the development of innovative products with superior nutritional value and favorable metabolic potential.

**Keywords:** functional foods, hypoglycemic, charantine, p-polypeptide, antidiabetic.

## Introduction



*Momordica charantia* (bitter cucumber) is one of the most studied medicinal plants with antidiabetic and hypoglycemic potential due to its rich content of bioactive compounds such as charantin, polypeptide-p, vicine, flavonoids and polyphenols. These compounds may contribute to blood glucose reduction by inhibiting carbohydrate-digesting enzymes, improving insulin sensitivity and stimulating glucose uptake.

In addition, the plant contains dietary fiber, vitamins, minerals and antioxidant compounds that can improve nutritional quality and reduce oxidative stress.

Traditional bakery products are generally characterized by a high carbohydrate content and low functional value, increasing the interest in developing healthier alternatives.



Figure 1. Morphological parts and processed forms of *Momordica charantia* used for the development of functional bakery products, edited with AI

## Material and method

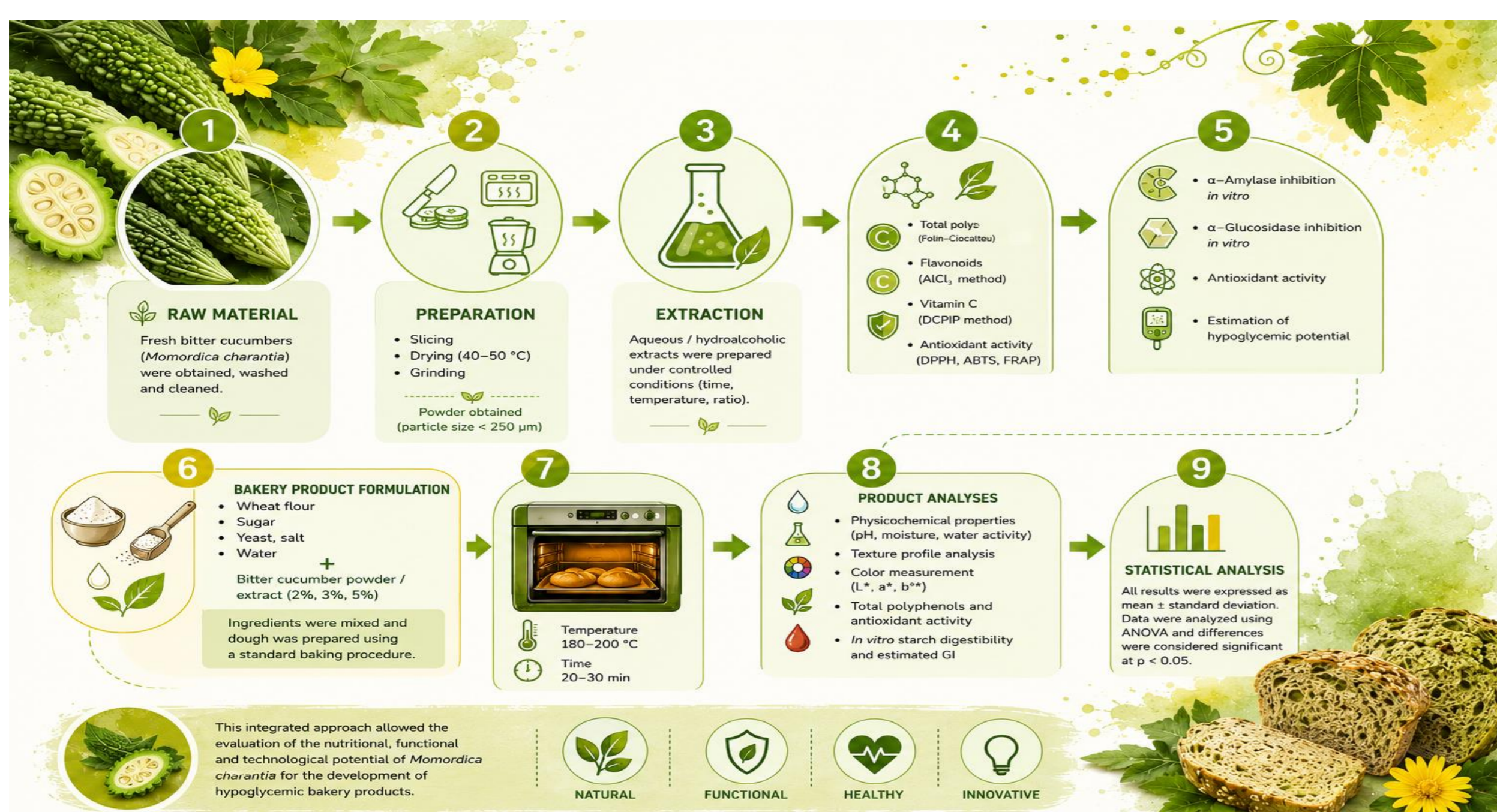


Figure 2. Experimental workflow for the development and evaluation of bakery products enriched with *Momordica charantia*, edited with AI

## Results and discussions

Table 1: Chemical, nutritional and phytochemical composition of the fruit, leaves, seeds and main forms of processing of the plant *Momordica charantia* based on databases and literature sources, per 100 g.

Component	Unit	Raw fruit	Leaves	Seeds	Seed oil	Standardized extract	Powder	Flour
Water (H <sub>2</sub> O)	%	88-92	70-75	5-8	0	4-6	6-10	8-12
Energy	kcal	17-20	45-55	420-480	880-900	250-300	280-320	300-340
Carbohydrates	g	3,5-4,0	6-8	12-18	0	20-30	55-65	60-68
Total Fiber	g	2,6	8-12	22-28	0	5-8	28-32	30-35
Protein	g	1,0-1,2	8-12	18-22	0	10-14	12-16	14-18
Lipids	g	0,2	4-5	28-32	100	1-2	2-4	3-5
Vitamin C	mg	80-90	100-120	2-4	0	5-8	10-15	12-18
Vitamin A (β-carotene)	μg	170	2,500-3,000	20-40	0	500-700	800-1200	900-1300
Potassium	mg	300-350	400-450	600-800	0	600-800	900-1100	950-1200
Magnesium	mg	17	40-60	150-200	0	50-70	80-120	90-130
Iron	mg	0,4	2-3	8-10	0	2-3	3-5	4-6
Zinc	mg	0,8	1-2	6-8	0	1-2	2-3	3-4
Charantin	mg	0,4-0,8	1-2	2-4	0	40-60	12-18	15-22
Polypeptide-p	mg	2-4	3,5	5-8	0	60-90	25-40	30-45
Vicina	mg	1-2	2-3	3-5	0	20-30	10-15	12-18
Cucurbitacins	mg	0,5-1,0	0,5-1,0	1-2	0	20-25	8-12	10-14
Total polyphenols	mg	70-120	250-300	150-200	20-40	600-900	350-500	400-550
Flavonoids	mg	20-40	180-250	40-60	5-10	200-300	120-180	150-200
Phenolic acids	mg	10-20	40-60	30-40	0	150-200	80-120	90-130
Antioxidant activity	-	Moderate	Very high	Moderate	Moderate	Very high	High	High
Glycemic index	-	Very low	Very low	Very low	Very low	Very low	Low	Low

## Conclusions

*Momordica charantia* demonstrated significant potential as a functional ingredient for the development of hypoglycemic bakery products due to its high content of dietary fiber, polyphenols and bioactive compounds such as charantin, polypeptide-p and flavonoids. The plant exhibited important hypoglycemic, antioxidant and nutritional properties, which may contribute to blood glucose regulation through the inhibition of  $\alpha$ -amylase and  $\alpha$ -glucosidase enzymes, improvement of insulin sensitivity and reduction of oxidative stress. The incorporation of bitter cucumber into bakery formulations may improve antioxidant capacity, fiber content and nutritional quality while maintaining acceptable technological and sensory characteristics at moderate incorporation levels.

These findings support the potential application of *Momordica charantia* as a promising natural ingredient for innovative functional bakery products intended for glycemic control and metabolic health improvement.