

PROCESS FOR PRODUCING WHITE KIDNEY BEANS IN SYRUP

Technical Field

The present utility model concerns preserved legume products, particularly to a process for producing white kidney beans (*Phaseolus vulgaris*) in syrup.

Background of the Utility Model

White kidney beans (*Phaseolus vulgaris*) are valued for their nutritional content, mild flavor, and versatility in both sweet and savory dishes. In the Philippines, they are commonly incorporated into desserts such as halo-halo and leche flan. They can also be served as snacks or partnered with other desserts like Suman Antala.

Conventional preservation methods may result in undesirable texture changes, discoloration, or microbial spoilage during storage. There is a need for a process that ensures product safety, extends shelf life, and maintains desirable sensory qualities such as color, texture, and flavor.

The present process addresses these needs by combining controlled heat processing, syrup preservation, and commercial sterility standards to produce a shelf-stable, ready-to-eat product suitable for retail distribution and culinary applications.

The sweet beans are prepared by bottling the soaked beans in a glass jar, hot-filled with sugar syrup and thermally processed to commercially sterilize the product, inactivating food spoilage microorganisms for food preservation and extension of shelf-life.

In this case, agitated retort is used which allows packed foods to have a uniform heat distribution with less processing time compared to static retorts that are commonly used locally that usually experience having differing temperature within

heated products, over-cooking and lack in consistency and flavor as a result from a large amount of heat required for thermal processing. Using agitated retort results in much energy saved and better product quality.

5 Agitated retort uses the special type of heat transfer which is forced convection where fluids are forced to move to increase the heat transfer and have a better quality of food products. It also prevents separation of food products in thermal processing and increases the rate of heat penetration to have a more uniform
10 heat distribution.

 KR102346378B1 relates to a method for manufacturing a soybean processed food and a soybean processed food manufactured by the method, and more particularly, to a method for manufacturing a soybean processed food having an original shape
15 and excellent texture through a high temperature sugar solution treatment process and a heat treatment process.

 US4273796A relates to a method for preparing precooked, dehydrated legumes which exhibit both minimal splitting or butterflying upon post cooking dehydration and minimal
20 hardspotting upon rehydration in warm water. The method comprises (A) cooking legumes in sugar solutions essentially ranging from about 5 to 7 Brix and at between about 180 DEG F. to 350 DEG F. until the legumes are tender and fully hydrated. Thereafter, the cooked legumes are (B) dehydrated to shelf stable
25 moisture contents of between about 4% to 12% using conventional dehydration techniques.

 CN102187976A provides a method for preparing instant kidney bean food comprising the steps of screening, cleaning, soaking, boiling the soaked materials, packaging, and sterilizing. The
30 soaking liquid used in the soaking process is a mixed aqueous solution of sodium chloride and glucose, wherein the mass concentration of sodium chloride is 0.1-0.9% and the mass concentration of glucose is 3-15%. The screened and cleaned

kidney beans are soaked in the soaking liquid for 36-72 hours, with a mass ratio of kidney beans to soaking liquid of 1:2-4. White sugar, in an amount equal to 1-9% of the mass of the kidney beans, is added during the boiling process of the soaked material.

Summary of the Utility Model

The present utility model relates to a process for producing white kidney beans (*Phaseolus vulgaris*) in syrup packed in glass jars and thermally processed using an agitated retort to achieve commercial sterility while preserving product quality. The process involves soaking the beans, filling glass jars with the soaked beans, hot-filling with sugar syrup, sealing, and subjecting the sealed jars to thermal processing in an agitated retort. The agitation ensures uniform heat distribution, faster heat penetration, and prevention of product separation during processing, thereby reducing overall processing time, saving energy, and enhancing the sensory qualities of the final product compared to conventional static retort processing. The product is typically consumed as a dessert or together with other Philippine local cuisine.

Detailed Description of the Utility Model

The present utility model provides white beans in syrup product made from dried white kidney beans (*Phaseolus vulgaris* L.) which are weighed, washed, soaked in water then in syrup, drained, and hot filled with sugar syrup in sterilized glass jars. The bottled white beans in syrup are then subjected to thermal processing in the multifunctional agitated-type retort with end-over-end agitation using water immersion mode, cooled, labelled accordingly, and stored in dry and clean storage room.

The white beans in syrup of the present utility model have better quality, intact nutritional values and processed in much

less time, avoiding over-cooking and differing temperature. The quality of the final product depends on the raw materials, soaking time, pressure, temperature, and time used in retort for processing which can be controlled by following the required standards (for raw materials and procedure) and optimum values (for retort processing).

The formulation of the white beans in syrup product is as follows: white kidney beans (59.52% w/w), refined sugar (12.15% w/w), and purified water (28.32% w/w). The percentage of refined sugar and purified water depends on the °Brix required. In this case, packing medium of extra heavy syrup with TSS of 30 °Brix is the basis.

"Extra heavy syrup", as used herein, refers to a packing medium consisting of an aqueous sugar solution with a total soluble solids content of 22 °Bx or higher, preferably between 30 °Bx and 50 °Bx, as measured by a refractometer at 20 °C, wherein the total soluble solids are predominantly sucrose derived from refined sugar.

The process begins with selecting and cleaning high-quality white kidney beans, which are then soaked in water until the desired hydration level is achieved. The hydrated beans are filled into clean glass jars, after which hot sugar syrup is added to the jars until the beans are fully submerged. The jars are then sealed with lids to prepare them for thermal processing.

Thermal processing is carried out in an agitated retort to achieve commercial sterility, ensuring the inactivation of food spoilage microorganisms and extending the shelf life of the product. Unlike static retorts, which rely primarily on natural convection and can result in uneven heat distribution, overcooking, or loss of flavor, the agitated retort utilizes forced convection through end-over-end or axial rotation of the jars during processing. This movement increases the rate of heat

penetration and promotes uniform heat distribution throughout the product.

5 The agitation also helps maintain the integrity of the product by preventing separation of solids and liquids during heating. As a result, the thermal process time can be significantly reduced, leading to lower energy consumption and better retention of texture, color, and flavor in the finished sweetened beans.

10 After thermal processing, the jars are rapidly cooled to ambient temperature to halt further cooking and maintain product quality. The final product is a commercially sterile, shelf-stable sweetened bean product suitable for distribution in local supermarkets.

15 Further features of the present utility model are apparent from the examples.

Examples

Example 1: Production of white kidney beans in syrup

Raw materials (white kidney beans, sugar, and purified
5 water) must conform to the following specifications:

- White kidney beans - must be of good quality, have uniform varietal characteristics, clean, ivory-colored skin, whole, firm, free from rancid odors, insects, discoloration, cracks, and other defects that affect
10 quality and general appearance. Beans that do not meet these standards shall be rejected.
- Sugar - must be naturally white in color, free from any residual color from the milling and refining process, free from moisture, non-lumpy, free from mold or any
15 organic growth, and free from insects, eggs, or other contaminants. Sugar containing foreign materials shall be rejected.
- Purified water - must be clear, odorless, and have no unusual taste. It must not be turbid or contain
20 suspended particles. Water that does meet these specifications shall be rejected.

White kidney beans that meet the quality specifications are weighed and washed to remove unwanted materials prior to heating.
25 Purified water is added to the washed white kidney beans and heated to 70 °C. A certain amount of lye water is added to the heated mixture to form a 2% v/v lye solution.

For example, for 150 g of white kidney beans, 500 mL of purified water is used for soaking. To obtain a 2% (v/v) lye
30 solution, 10 mL of lye water is added to 500 mL of purified water.

The beans are soaked in the lye solution for four (4) hours, then drained and washed three (3) times to ensure that no traces

of lye remain. The hydrated beans are cooked in extra heavy syrup (50 °Bx) for 5 minutes at boiling temperature and soaked in the same syrup for 12 hours. The soaking syrup is then drained.

5 The drained beans are hot-filled into sterilized glass jars with syrup as the packing medium. The ratio of solids to syrup is 1.5:1.0. The packing medium must be at least 90 °C, and a headspace of 1 cm is maintained.

10 The jars are sealed with metal caps while the temperature is about 80 °C, ensuring removal of any bubbles prior to sealing. The sealed jars are loaded vertically in the retort basket and processed under water immersion with end-over-end agitation, with water pre-heated to 60 °C. The retort temperature is set to 121 °C at 0.18 MPa. Cooling is initiated when accumulated lethality (F_0) of at least 3 minutes is achieved, or according
15 to a validated thermal process based on Heat Penetration Testing (HPT) using *Clostridium botulinum* as the target microorganism.

20 Finished products are stored in a clean, dry area protected from moisture, excessive heat, dust, dirt, and other contaminants. The storage area must be pest- and rodent-free to prevent contamination.

Table 1. Material balance and product yield

Ingredient	Initial weight (kg)	Weight after water soaking (kg)	Weight after syrup soaking (kg)	Weight of product in glass jars (kg)	Formulation	%Recovery
White Beans	6.00	12.00	12.50	12.50	59.52	26.86***
Lye	0.36	12.36*				
Purified water 1	18					
Sugar		11.09	21.68**			
Purified water 2		11.09				
Sugar 2				2.55	12.15	
Purified water 3				5.95	28.32	
Total weight (g)		46.54		21.0		
Product Yield	50 jars (420 g)					
Yield	26.86%					

*Combination weight of lye and purified water were discarded

**Excess sugar syrup used was discarded

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Example 2: Sensory, physicochemical, and microbiological characterization of produced white kidney beans in syrup

Table 2. Descriptive sensory characteristics

Color	Golden-brown in color due to the impregnation of the caramelized sugar.
Aroma	A combination of the nutty scent of white beans and warm, sugary fragrance of the syrup.
Taste	The delicate sweetness of the sugar syrup permeates the beans and harmonizes with its nutty flavor.
Texture	Slightly soft and gives a smooth mouthfeel.

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Table 3. Sensory acceptability

Attribute	Score (9-point Hedonic scale)	
	30°Brix packing syrup, 17.5 rpm agitation speed	50°Brix packing syrup, 35 rpm agitation speed
Color	6.98 ± 1.04	6.04 ± 1.56
Appearance	7.06 ± 1.25	5.92 ± 1.52
Overall	7.06 ± 1.11	6.10 ± 1.43

10 Table 4. Color and texture

Property	30°Brix packing syrup, 17.5 rpm agitation speed	50°Brix packing syrup, 35 rpm agitation speed
Color - L^* (lightness)	50.57 ± 0.40	44.53 ± 0.59
Color - a^* (redness)	4.32 ± 0.04	4.43 ± 0.18
Color - b^* (yellowness)	20.07 ± 0.24	18.99 ± 0.57
Hardness (kgf)	1.63 ± 0.07	2.36 ± 0.15

Table 5. Physicochemical properties

Property	30°Brix packing syrup, 17.5 rpm agitation speed	50°Brix packing syrup, 35 rpm agitation speed
Aw (solids)	0.951 ± 0.009	0.925 ± 0.000
pH (syrup)	6.90 ± 0.14	6.89 ± 0.12
TSS (syrup)	38.25 ± 1.03	48.25 ± 0.27

Table 6. Microbiological quality (commercial sterility test)

Parameter	Result	Test Method
Mesophilic aerobes	Negative	Commercial Sterility Test (FDA BAM Chapter 21A, January 2001)
Mesophilic anaerobes	Negative	
Thermophilic aerobes	Negative	
Thermophilic anaerobes	Negative	

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