SPECIFICATION

A PROCESS FOR PRODUCING A READY-TO-EAT (RTE) ADLAI (*Coix-lacryma-jobi L.)* CHAMPORADO

TECHNICAL FIELD

The present utility model generally relates to food production processes but more particularly to a process for producing a ready-to-eat (RTE) adlai champorado

BACKGROUND OF THE UTILITY MODEL

Adlai (*Coix-lacryma-jobi L.*) plant, also known as Job's tear or Chinese pearl barley yield grains being referred to as adlai. Adlai is an alternative staple food for the popular padded rice (*Oryza sativa*) and corn (*Zea mays*) or maize. Adlai carries nutritional significance due to its low glycemic index and high protein contents compared to other crops. It is being compared to high valued crops like quinoa based on nutritional benefits but with lesser cost. As reported, adlai contains 50% starch, 14% protein and 6% fat (FAO, 2012). Adlai is underutilized because most Filipino consumers are not yet familiar with its various food applications and health benefits. The crop is being promoted by the Department of Agriculture (DA) as an alternative source of healthy staple food.

To familiarize Filipino consumers, the most popular rice-based products will be used as benchmark in the formulation of adlai-based products. Among the products identified is the Adlai champorado. The developmental stage will focus on enhancing the acceptability of adlai-based products in terms of flavor/taste and texture. For adlai, the crop requires an appropriate processing and packaging technologies that will increase its commercial value and acceptability to Filipino consumers. Adlai has lesser acceptability compared with rice based on the previous studies conducted by Dela Torre (2018) and Mamucod et al. (2020). Researchers are continuously conducting research to use adlai as an alternative staple food not only because it could reduce the country's dependency on crops with high environmental impact like rice and corn but most importantly for its

nutritional value. Currently, more farmers are planting adlai and the demand for the crop is increasing. Adlai can be seen in the market in grit or grain form.

During the 2021 ENNS National Dissemination of DOST-FNRI, it was presented that 36.4% of Filipinos ages 20 and above have prevalence of impaired fasting glucose and another 8. I% with high fasting blood sugar. This accounts of about 30 million Filipinos based on the 68 million population of Filipinos under the age group. There is also 14.4 % prevalence of elevated blood pressure among adults ages 20 to 59 and 33.4% to 60 years and above. Adlai will be an attractive product for these niche market as it has lower glycemic index compared to rice (Meng-Hsueh et al., 20 I 0), and as compared earlier it has cheaper price than the imported quinoa. Adlai has also higher protein content when compare to rice and com which are suitable to the work activities of military and police personnel which can be considered in addition to the target market.

Coupling the properties of adlai as good staple food with an appropriate packaging technology will be an effective approach to capture the niche market. Development of new adlai products using retort pouch packaging technology is one of the technologies to produce RTE meals which is expected to reach USO 2,023.2 million by 2028 (6Wresearch, 2023). This technology uses retort pouch that can withstand thermal processing, and retort chamber with counter pressure. Requirements for the technology are available in the country and feasible for companies to expand production to serve the niche market. The technology does not just promise product protection but as well as bringing adlai to be positioned in a competitive market. For total packaging solution, transport packaging as well as brand and label design should also be a consideration.

PH2/2020/000172 discloses the processing method of producing ready-to-eat chocolate rice porridge. The said patent developed a process to create nutritious meal for breakfast or snack time, thereby giving a healthy alternative or substitute to instant noodles of canned foods. The process includes a) preparation of ingredients: washing and soaking of rice, coconut milk, pure tablea and brown sugar; b) precooking a liquid mixture prepared by combining fresh coconut milk,

pure tab lea, brown sugar and water; c) filling of retortable stand-up pouch with water soaked rice; d) adding the pre-cooked mixture in the stand-up pouch in a vertical non-agitating water retort for an hour at 116°C.

The objective of the utility model is to develop a process that will produce new product from adlai that can be commercia11y available for general population most special1y to the niche market, people with prevalence of impaired fasting glucose and with high fasting blood sugar, elevated blood pressure, and working extraneous activities like military and police personnel. The adlai champorado should have features of ready-to-eat, shelf stable and long product shelf life. With the above mentioned process, the process develop for ready to eat shelf stable adlai champorado is different due to the following: 1) Ingredients used are adlai grits (not rice), cacao powder (not pure tablea), water, muscovado sugar (not brown sugar), and modified starch (not indicated in PH2/2020/000172). The newly developed process did not use coconut milk; 2) The new process has pre-cooking of adlai in boiling water which make it different to PH2/2020/000172 as it only soak rice in water; and boiling of liquid has cacao powder, water, muscovado and modified starch. No coconut milk added. Cacao powder was used rather than pure cacao tablea for easy incorporation. Modified starch was used to improve product consistency; 3) Separate filling of pre-cooked adlai and boiled chocolate mixture, 4) The retort temperature used in new process is 118°C and not 116°C.

SUMMARY OF THE UTILITY MODEL

Disclosed is a process of producing new product using adlai grits. The product, adlai champorado using adlai grits, was applied with retort pouch packaging technology to become ready-to-eat and shelf stable. The process was established using the appropriate ratio of adlai grits and water, pre-cooking time, amount of modified starch, amount of chocolate powder, amount of sugar, and retort processing parameters to produce the desired quality of the product. Product was packed in two types of high barrier retort pouch and applied with retort pouch packaging technology to achieve shelf life of 1 year or more at ambient storage condition (32±4°C).

The utility model aims to produce new product using adlai, an alternative staple food to rice and com. With the application of retort pouch packaging technology, new product was developed for adlai with the feature of long product shelf life of I year or more at ambient temperature (32±4°C) using either vapor release Alox-PET/Nylon/ RCPP or PET/Aluminum/Nylon/CPP. The present utility model will offer a new kind of food in the market particularly to its niche market, 30 million men and women Filipinos ages 20 and above with prevalence to impaired fasting glucose and high fasting blood glucose (2018- 2019 ENNS, DOST-FNRI; PSA, 2020).

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

Fig. 1 is a flowchart of a process of producing RTE adlai champorado.

DETAILED DESCRIPTION

Effect of retorting on adlai champorado was determined to establish the pre-treatment of the product. Results of the experiment conducted showed that non-retorted and retorted adlai champorado have significant differences in appearance, consistency and texture of adlai grits based on the sensory evaluation (Table 1). Panelists perceived more acceptable sensory properties of non-retorted adlai champorado than the retorted one. They rated the overall acceptability of non-retorted adlai champorado 'like moderately' while 'neither like nor dislike' for retorted one. Panelists also observed an intense degree of chocolate taste in adlai champorado.

In terms of physicochemical tests (Table 2), significant differences were found in pH and color. A lower pH was recorded after retort processing. A higher a-value for color was also noted but not in L and b- values.

Table 1. Sensory evaluation of non-retorted and retorted adlai champorado

Sensory Attributes	Condition(s)	
	Non-retorted	Retorted
Appearance	3.08 ± 1.32 a	2.08 ± 0.86 b
Acceptability of Appearance	7.17 ± 1.95 a	5.42 ± 1.38 b
Aroma	8.00 ± 0.71 a	7.33 ± 1.43 a
Consistency	2.92 ± 0.76 a	6.83 ± 0.55 b
Acceptability of Consistency	6.75 ± 1.58 a	3.92 ± 1.80 b
Texture (adlai grits)	5.08 ± 0.86 a	2.25 ± 1.53 b
Acceptability of Texture	6.75 ± 1.64 a	5.58 ± 2.06 a
Taste	4.08 ± 1.19 a	4.08 ± 1.38 a
Degree of chocolate taste	6.25 ± 0.72 a	6.25 ± 0.92 a
Overall Acceptability	7.08 ± 1.24 a	4.92 ± 1.78 b

Values are expressed as mean ± standard deviation. Means followed by the same letter within row are not significantly different at p=0.05 (*n*=14)

Legend: **Appearance**: 1=extremely dark, 2= moderately dark, 3= slightly dark, 4=just right, 5= slightly light, 6= moderately light, 7=extremely light; **Acceptability of Appearance**: 9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely; **Aroma:** 9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely; **Consistency:** 1=extremely thick, 2= moderately thick, 3= slightly thick, 4=neither thick nor thin, 5= slightly thin, 6= moderately thin, 7=extremely thin; **Acceptability of texture:** 9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely; **Texture:** 1=extremely hard, 2= moderately hard, 3= slightly hard, 4=just right, 5= slightly soft, 6= moderately soft, 7=extremely soft; **Acceptability of texture:** 9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely; **Taste:** 9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely; **Degree of chocolate taste:** 7=Moderate to strong, 6=Moderate, 5=Slight to moderate, 4=Slight, 3=Very slight, 2= Threshold, 1=None; **Overall acceptability**:9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely

Table 2. Physicochemical tests of non-retorted and retorted adlai champorado

Physico-chemical test	Condition(s)	
	Non-retorted	Retorted
pH	6.36 ± 0.01a	6.17 ± 0.03b
Water activity	0.991 ± 0.001a	0.989 ± 0.004 a
Color		
L	28.04 ± 0.75 a	28.64 ± 0.09 a
a	9.71 ± 0.52 a	10.43 ± 0.71 b
b	11.03 ± 1.00 a	11.63 ± 0.98 a

Means followed by the same letter within row are not significantly different at p=0.05, for pH and aw, n=6, for aw n=8

Based on the initial results, pre-treatments for RTE adlai champorado was established by conducting experiments on 1) concentration of chocolate, 2) ratio of adlai and chocolate mixture, and 3) use of modified starch.

1. Concentration of chocolate

The original chocolate mixture has a ratio of cacao powder: water: sugar. Panelists observed an intense degree of chocolate taste for the basic recipe.

To optimize the degree of chocolate taste, cacao powder was decreased to two concentrations of chocolate: 2% and 4% from the original concentration of 6% of chocolate mixture. The two chocolate mixtures were added separately to the pre-cooked adlai boiled for 3 minutes in a ratio of I :6 (adlai grains: water). Both lots of adlai champorado with different chocolate concentrations were retorted in pouches. Finished products were subjected to sensory evaluation (Table 3). Panelists preferred the concentrations with a higher amount of chocolate powder (4% cacao powder based on weight of water).

Based on the study of Tri Putri and Sukma (2021), flavor contributes further to toppings in chocolate products and is considered second most important to consumers. Since adlai champorado has no topping, concern of chocolate flavor will be the primary consideration.

Table 3. Sensory evaluation of adlai champorado in varying concentrations of chocolate.

Sensory attributes	Percentage of chocolate	
	2%	4%
Consistency	6.21 ± 0.86 a	6.00 ± 0.85 a
Acceptability of Consistency	7.50 ± 0.73 a	7.57 ± 0.90 a
Intensity of chocolate taste	6.64 ± 1.23 a	7.79 ± 0.74 b
Acceptability of chocolate taste	6.71 ± 1.79 a	7.86 ± 1.12 b
Overall Acceptability	7.29 ± 0.88 a	7.50 ± 0.63 a

Values are expressed as mean ± standard deviation. Means followed by the same letter within row are not significantly different at p=0.05 (*n*=14)
Added percentage of chocolate is based on the weight of water.

Legend: **Consistency**: 1=extremely thick, 2= moderately thick, 3= slightly thick, 4=neither thick nor thin, 5= slightly thin, 6= moderately thin, 7=extremely thin; **Acceptability of Consistency**: 9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely; **Intensity of Chocolate taste**: 1=extremely high, 2= moderately high, 3= slightly high, 4=neither high nor low, 5= slightly low, 6= moderately low, 7=extremely low; **Acceptability of Chocolate taste**: 9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely; **Overall acceptability**:9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely.

2. Ratio of adlai and chocolate mixture

In improving the chocolate flavor of adlai champorado, 3 ratios of pre-cooked adlai to chocolate mixture (6:34, 7:33, and 8:32) were prepared. Finished products after retorting were evaluated by the panelists and based on the results (Table 4), the 6:34 ratio of chocolate mixture was preferred.

Table 4. Sensory evaluation of adlai champorado in varying percentages of solids.

Sensory attributes	Ratio of pre-cooked adlai to chocolate mixture		
	6:34	7:33	8:32
Appearance	2.86 ± 1.06 a	3.29 ± 1.28 a	3.79 ± 1.37 a
Acceptability of Appearance	8.00 ± 0.76 a	7.36 ± 1.11 a	7.21 ± 1.26 a
Aroma	8.29 ± 0.70 a	7.93 ± 0.96 a	7.93 ± 0.96 a
Consistency	5.43 ± 0.90 a	6.29 ± 0.70 b	6.57 ± 0.62 b
Acceptability of Consistency	7.50 ± 0.98 a	6.50 ± 1.64 b	5.93 ± 1.83 b
Texture (adlai grits)	3.07 ± 0.88 a	3.00 ± 0.93 a	2.57 ± 1.18 a
Acceptability of Texture	7.21 ± 1.01 a	6.07 ± 1.87 a	5.93 ± 2.15 a
Taste (sweetness)	3.57 ± 0.73 a	3.29 ± 0.88 a	3.07 ± 0.96 a
Degree of chocolate taste	6.14 ± 0.99 a	5.79 ± 1.08 a	5.43 ± 1.12 a
Overall Acceptability	7.64 ± 0.50 a	6.07 ± 1.77 b	5.43 ± 1.91 b

(Product net weight = 200g)

Values are expressed as mean ± standard deviation. Means followed by the same letter within row are not significantly different at p=0.05 (*n*=14)

Legend: **Appearance**: 1=extremely dark, 2= moderately dark, 3= slightly dark, 4=just right, 5= slightly light, 6= moderately light, 7=extremely light; **Acceptability of Appearance**: 9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely; **Aroma:** 9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely; **Consistency:** 1=extremely thin, 2= moderately thin, 3= slightly thin, 4=just right, 5= slightly thick, 6= moderately thick, 7=extremely thick; **Consistency Acceptability:** 9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely; **Texture:** 1=extremely hard, 2= moderately hard, 3= slightly hard, 4=just right, 5= slightly soft, 6= moderately soft, 7=extremely soft; **Texture Acceptability:** 9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely; **Taste:** 7=Extremely sweet, 6= Moderately sweet, 5= Slightly sweet, 4=Just right, 3= Slightly less sweet, 2= Moderately less sweet, 1=Extremely less sweet; **Degree of chocolate taste:** 1=Moderate to strong, 2=Moderate, 3=Slight to moderate, 4=Slight, 5=Very slight, 6= Threshold, 7=None; **Overall acceptability**:9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely

Adlai champorado with different ratios of pre-cooked adlai and chocolate mixture were also subjected to physicochemical analysis. Based on the results, the identified ratio preferred by panelists which is the 6:34 is not significantly different with the other two ratios in terms water activity and a-value in color but is significantly different among the two ratios in pH, TSS, and color lightness (L). The proportion of ingredients affects the parameters of adlai champorado.

Table 5. Physicochemical tests of adlai champorado in varying ratio of solids to chocolate mixture

Physico-chemical test	Ratio (solids : chocolate mixture)		
	6:34	**7:33**	**8:32**
pH	6.42 ± 0.03 a	6.44 ± 0.05 a	6.39 ± 0.05 b
Water activity	0.992 ± 0.003 a	0.996 ± 0.002 a	0.992± 0.001 a
TSS	11.70 ± 1.25 a	8.00 ± 2.77 b	6.17 ± 1.68 c
Color			
L	30.4 ± 0.56 a	31.4 ± 0.59 b	31.3 ± 0.14 b
a	11.9 ± 0.18 a	12.4 ± 0.33 a	11.5 ± 0.08 a
b	12.9 ± 0.24 a	14.8 ± 0.49 b	14.3 ± 1.74 b

(Product net weight = 200g)

3. Use of modified starch

To improve the consistency of retorted adlai champorado (6:34 ratio), three levels of concentration of modified starch were used (0.5, 1.0 and 1.5%). Three adlai champorado added with modified starch packed and retorted were subjected to sensory evaluation. Based on the results, the most acceptable consistency was the adlai champorado added with 0.5% modified starch.

Adlai champorado (6:34) added with 0.5% modified starch, aside from having the highest acceptability, has also the highest intensity of chocolate taste. Panelists rated the adlai champorado with 0.5% modified starch "like very much"

Table 6. Sensory evaluation of adlai champorado in varying concentration of MS.

Sensory attributes	Modified starch concentration (MS)		
	0.5%	1.0%	1.5%
Consistency	4.88 ± 0.93 a	3.25 ± 0.83 b	5.50 ± 0.50 c
Acceptability of Consistency	7.50 ± 0.73 a	7.13 ± 1.36 a	7.38 ± 0.70 a
Intensity of chocolate taste	6.88 ± 1.05 a	6.50 ± 1.32 a	6.75 ± 0.97 a
Acceptability of chocolate taste	8.00 ± 0.87 a	7.75 ± 0.83 a	7.75 ± 1.73 a
Overall Acceptability	7.63 ± 0.86 a	7.00 ± 1.12 a	7.50 ± 0.50 a

Values are expressed as mean ± standard deviation. Means followed by the same letter within row are not significantly different at p=0.05 (*n*=14)

Legend: **Consistency:** 1=extremely thin, 2= moderately thin, 3= slightly thin, 4=just right, 5= slightly thick, 6= moderately thick, 7=extremely thick; **Acceptability of consistency:** 9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely; **Intensity of chocolate taste:** 1=Moderate to strong, 2=Moderate, 3=Slight to moderate, 4=Slight, 5=Very slight, 6= Threshold, 7=None; **Acceptability of chocolate taste:** 9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely; **Overall acceptability**:9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely

Table 7. Heating parameters for RTE parboiled adlai in retort pouch (200 g).

No. trial (s)	Heating parameters	
	jh	fh
1	0.33	15.70
2	0.38	15.17
3	0.33	15.17
4	0.40	14.57
5	0.38	16.89

Adlai champorado in two types of packaging produced using the established process schedule was evaluated for sensory evaluation and physicochemical analysis shown in Tables 8 and 9 respectively. Table 8 shows the evaluation of Alox-PET/Nylon/RCPP with vapor release and PET/Aluminum/Nylon/CPP processed with parboiled adlai.

Based on the sensory evaluation results (Table 8), significant differences between the two products were observed in appearance, taste (chocolatiness), and overall acceptability. Adlai champorado packed in foil pouch (PET/Aluminum/Nylon/CPP) had a darker color and a higher rating in terms of taste

and overall acceptability compared to product packed in vapor release pouch (Alox-PET/Nylon/RCPP). Both products were rated as "liked very much" in terms of taste and overall acceptability.

Table 8. Sensory evaluation of established processing time for RTE adlai champorado processed in Alox-PET/Nylon/RCPP with vapor release and PET/Aluminum/Nylon/CPP

Sensory attributes	Retortable pouches	
	Alox-PET/Nylon/RCPP	**PET/Aluminum/Nylon/ CPP**
Appearance	3.64 ± 2.38 a	2.86 ± 2.13 b
Acceptability of Appearance	7.86 ± 1.46 a	8.29 ± 0.70 b
Aroma	8.00 ± 1.13 a	8.21 ± 0.67 a
Consistency of champorado	4.93 ± 1.58 a	5.21 ± 1.52 a
Consistency acceptability	7.43 ± 1.45 a	8.00 ± 0.76 a
Texture (adlai grits)	4.00 ± 1.41 a	3.31 ± 0.61 a
Texture acceptability	7.85 ± 0.86 a	8.08 ± 0.47 a
Taste (sweetness)	7.85 ± 1.03 a	8.31 ± 0.46 a
Taste (chocolatiness)	7.77 ± 0.97 a	8.31 ± 0.46 b
Overall acceptability	7.92 ± 0.92 a	8.38 ± 0.49 b

Values are expressed as mean ± standard deviation. Means followed by the same letter within row are not significantly different at p=0.05 (*n*=15)

Legend: **Appearance**: 1=extremely dark, 2= moderately dark, 3= slightly dark, 4=just right, 5= slightly light, 6= moderately light, 7=extremely light; **Acceptability of Appearance**: 9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely; **Aroma:** 9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely; **Consistency:** 1=extremely thin, 2= moderately thin, 3= slightly thin, 4=just right, 5= slightly thick, 6= moderately thick, 7=extremely thick; **Acceptability of consistency:** 9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely; **Texture:** 1=extremely soft, 2= moderately soft, 3= slightly soft, 4=just right, 5= slightly hard, 6= moderately hard, 7=extremely hard; **Texture Acceptability:** 9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely; **Taste:** 9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely; **Overall acceptability**:9=Like extremely, 8=Like very much,7=like moderately, 6= like slightly, 5= neither like nor dislike, 4=dislike slightly, 3= dislike moderately, 2= dislike very much, 1=dislike extremely

Table 9. Physico-chemical tests of established processing time for RTE adlai champorado (200 g) processed in Aiox-PET/Nylon/RCPP with vapour release and PET/Aluminum/Nylon/CPP

Parameter	Retortable pouches	
	Aiox-PET/Nylon/RCPP	PET/Aluminum/Nylon/CPP
pH	6.19 ± 0.05 a	6.17 ± 0.02 a
Water activity	0.989 ± 0.001 a	0.989 ± 0.001 a
TSS	8.8 ± 0.00 a	8.98 ± 0.41 a
Color		
L	23.0 ± 1.28 a	26.2 ± 2.22 b
a	9.3 ± 0.94 a	9.4 ± 1.43 b
b	11.1 ± 1.86 a	11.9 ± 3.86 b

Means followed by the same letter within row are not significantly different at p=0.05, for pH and aw, n=6, for color n=8.

Table 10. Evaluation of retortable pouches using the established processing time for RTE adlai champorado (200 g).

	Retortable pouches	
Parameters/Properties	Alox-PET/Nylon/ RCPP	PET/Aluminum/Nylo n/CPP
Seal strength, N/15mm Manufacturer's seal Toll packer's seal	 59.737 40.273	 62.870 36.070
Oxygen Transmission Rate, cc/m^2-day	52.270	0.022
Ability to withstand 118°C	Can withstand retort processing time &temperature	Can withstand retort processing time &temperature
Visual inspection for change in appearance and flex crack	No delamination & no change in color of pouches	No delamination & no change in color of pouches

The RTE adlai champorado is a new product made using adlai, the commodity being promoted by Department of Agriculture as an alternative staple food to rice and corn. Adlai is a good alternative ingredient as research in modern medicine has confirmed its beneficial effects on health, including the ability to regulate blood sugar. blood lipids, blood pressure to improve gastrointestinal physiology and reproductive endocrine hormones (Hsia et al., 2007). Establishment of the process to create new product from adlai wi l l help the Food Industry to cater the need or niche market, 30 million men and women Filipinos ages 20 and above with prevalence to impaired fasting glucose and high fasting blood glucose (201 8 - 20 1 9 ENNS, DOST-FNRI; PSA. 2020). Military

and police with population of 151,000 (Global firework, 2023) and 207,642 respectively (PSA. 2021) are also potential markets.

Coupling the properties of adlai as good staple food with an appropriate packaging technology will be an effective approach to capture the niche market. Development of new adlai products using retort pouch packaging technology is one of the technologies to produce RTE meals which is expected to reach USD 2,023.2 million by 2028 (6Wresearch, 2023). This technology uses retort pouch that can withstand thermal processing, and retort chamber with counter pressure. Requirements for the technology are available in the country and feasible for companies to expand production to serve the niche market. The technology does not just promise product protection but as well as bringing adlai to be positioned in a competitive market.

The recap, the process for producing ready-to-eat (RTE) adlai champorado having a shelf stable feature comprises the following steps, to wit:

a.) Pre-cooking adlai which can be in grits or any form of its as raw material in boiling water, the ratio of adlai and water of 1:6 to 1:10 by weight for a period of 3 to 9 minutes;
b.) Preparing a chocolate sauce with 2 to 4% cocoa powder, 10-11% muscovado sugar, and 0.5 to 1.5% modified starch based on weight of water;
c.) Mixing pre-cooked adlai and chocolate sauce in a ratio of 6:34 to 8:32 by weight;
d.) Filling two-hundred grams (200g) of the mixture in a retort pouch;
e.) Sealing the mixture-containing retort pouch; and
f.) Retorting the retort pouch at 118°C to achieve condition with sterility value of 3.5 minutes.

The preferred variety of adlai is Gulian over other varieties of the plant.