Process Optimization, Consumer testing and Shelf-life Determination of Canned "*Halang-halang*": A Filipino Traditional Food

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Abstract— *Halang-halang and tagutoare the Filipino names given to the hot and spicy pulutan (finger food) prepared from finely chopped across of young native chickens stewed in coconut milk with chopped chillies and spices. The basic formulation and process of halang-halang need to be assessed especially as canned product for longer shelf life and wider distribution. Thus, this research optimizes the formulation, processing conditions and determines shelf-life and proximate composition of canned halang-halang. Three identified factors were used in the optimization experiment following the Box-Benhken Design (BBD)with 15 treatments. Three levels of coconut milk (0, 20, 40%), sautéing time (0, 3, 6 minutes) and processing time (30, 40 and 50 minutes) were used. Different treatments were subjected to sensory evaluation, optimization and verification test. Response surface regression (RSREG) analysis was used to determine the optimum level of coconut milk, sautéing and processing time combinations. Optimum formulation was achieved at mid-level coconut milk (20%), longer (50 minutes) or shorter (30 minutes) processing time and at any sautéing time. Both coconut milk level and processing time significantly influenced the sensory qualities of the product, while sautéing time showed no significant effect in all response variables. Verification test confirms that optimum formulation is better in acceptability scores compared to treatment outside the optimum region. Both the developed "plain" and "hot" halang-halang formulations have high preference from young and adult consumers. After 15 months of storage, canned halang-halang products were still microbiologically acceptable showing a microbial count much lower than the safe level.*

Keywords— Traditional food, Box-Benhken Design, canning, proximate analysis, shelf-life determination.

I. INTRODUCTION

Poultry has become increasingly popular in recent years, because it is inexpensive, versatile and considered a cheaper source of protein. The ability of poultry to adapt to most areas of the world, the rapid growth rate of poultry and the rapid generation time, all make poultry an ideal rich source of animal nutrients for human food. It has been estimated that chicken appears in the diet of more people throughout the world as a source of meat than the meat of any other animal (Labensky and Hause, 1995).According to Buzby and Farah (2006), the increase in consumption of chicken has doubled between 1970 and 2004, from 27.4 pounds per person to 59.2 pounds. Chicken consumption has been gaining ground against beef.

The Philippine native chicken (*Gallus gallusdomesticus*) is a great substitute for commercial poultry chicken. Generally known to be self-supporting and well adapted to their scavenging existence, they survive and reproduce under minimal care and management. Many consumers feel that chickens that are allowed to move freely and forage for food have a better flavor compared to chickens that are raised indoors in chicken houses. Moreover, certain flavor characteristics of their meat and eggs have fancily induced some people to continue raising these indigenous and nondescript mongrels over that of the commercial hybrid broiler.

There has been an increasing demand around the world for spices and spicy foods during the last few years because of the increased production of convenience foods. Spices improve the flavor and give pungency to foods. Some spice components also are known to act as microbial antagonists (Lai and Roy, 2004). The meat industry and soup manufacturers use the largest quantities of spices.

Halang-halang and Taguto are the Filipino names given to this hot and spicy food usually consumed as *pulutan* (finger food) for most beer drinkers in the province of Leyte, Philippines. The cooking of *halang-halang* came from the idea of utilizing the young female chickens that are culled or considered useless for fighting cock purposes. It is made from finely chopped carcass of young (approximately 4 months old) mostly female native chickens stewed in coconut milk with high amount of chopped chili and spices. Since the bones are included it is rich in major nutrients like calcium. *Halang-halang* is also

considered as an ethnic product that actually originated in Leyte. This product might be consumed as viand if it is with plain or unspiced formulation.

Halang-halang is not new since many people living in the southern villages in Leyte, Philippines have already tasted this product (J.M.Lasquites, personal communication, January 20, 2014). However, its basic formulation and process need to be optimized especially as a canned product for longer shelf life and wider distribution. This could make it possible for this poultry product to be transported to different areas throughout the world. Thus, this research project was conducted to optimize the formulation, processing conditions, consumer testing and shelf-life determination of canned *halang-halang*.

Specific Objectives of the Study

1. Determine the consumer acceptability of canned plain "*halang-halang"* at different parameter levels and combinations.
2. Determine the optimum combination of coconut milk, length of sautéing and retort time for canned *halang-halang* based on consumer acceptability.
3. Determine the consumer preference of the "plain" and "hot" *halang-halang* samples.

II. MATERIALS AND METHODS

2.1 Experimental Design

Following the Box-Benhken Design (Meyer and Montgomery, 1995) a 3^3 fractional factorial design was followed using coconut milk, length of sautéing and retort time combinations as independent variables. A total of 15 treatments (Table 1) were used including three replications at the center point. Chosen levels are 0, 20 and 40% coconut milk: 0, 3, and 6 min sautéing time and 30, 40, and 50 minutes for retort time.

TABLE 1
THE DIFFERENT TREATMENTS OF THE BOX-BEHNKEN DESIGN FOR 33 FRACTIONAL FACTORIAL EXPERIMENTS AS APPLIED IN EVALUATING THE QUALITY OF CANNED "PLAIN" *HALANG-HALANG*.

Treatment	Sautéing time (minutes)	Coconut milk (%)	Retort time (minutes)
1	0	20	30
2	6	20	30
3	6	20	50
4	0	20	50
5	0	40	40
6	3	40	30
7	6	40	40
8	3	40	50
9	0	0	40
10	3	0	30
11	6	0	40
12	3	0	50
13	3	20	40
14	3	20	40
15	3	20	40

At 100% chicken

2.2 (a) Preparation of Ingredients

Chicken Meat. The cleaned carcass was cut into quarters and chopped into small pieces of about 0.3 to 0.4 cm in length.

Coconut milk. Matured coconuts were dehusked, grated and milk extracted without added water. The extracted milk was divided into two equal portions and was placed in separate containers.

Other Ingredients. Chilies, onion bulb and onion stalks were chopped into small pieces before use.

2.2 (b) Preparation of Canned *Halang-halang*

***Cooking*.** Different spices such as ginger (62.96g), and garlic (37g) together with the chopped poultry (1000g) were sautéed in a frying pan until light brown. Half portion of the coconut milk (150g) was added to the mixture and was stirred occasionally until boiling. Monosodium glutamate (3.7g), salt (55g) and chopped chillies (18g) for "hot" formulation were added and were cooked for 5 minutes. Onions (74g) and the remaining portion of the coconut milk (150g) was the added to the final mixture and cooked for 3 minutes.

Cleaning of Cans. Container cans were cleaned and sterilized.

Filling. The filling of the cooked product was done manually right after cooking into sterile cans.

Seaming. The filled cans were covered with can cover and were sealed using a double seam can sealer. Double seam sealing was employed in closing the cans. Careful attention was done and possible leakage and distorted seams were checked for after seaming.

Processing. The sealed cans were placed in an autoclave. The autoclave was tightly closed and was switched on. The stopcock of the autoclave was opened first and was closed 3 minutes after the steam came out from the cock. Counting of retort time started when the retort temperature has already reached 250^{o}F. Different retort times were used at a constant retort temperature of 250^{o}F.

Cooling. After retorting, the autoclave was switched off and the stopcock was slightly opened. The autoclave was allowed to register a zero pressure reading before it was opened. The hot cans were removed and were rinsed in cold water to facilitate the cooling process. The cans were wiped with clean, dry cloth and were stored in a cool dry place.

***Can Seam Evaluation*.** External check-up of can seam was done to check for possible gross abnormalities. Checking and measuring of seamed can samples were done carefully along the periphery of the can seam with the aid of a micrometer calliper.

2.3 Sensory Evaluation

All sensory evaluation activities were carried out to determine the acceptability of the product ("plain" formulation) from the 15 different treatments right after a day of storage. Samples from the different treatments were presented using an Incomplete Block Design to a group of 28 panelists composing of students who evaluated the products' color, aroma, texture, flavor, and general acceptability.

2.4 Optimization

Response surface regression (RSREG) analyses using SAS Statistical Computer Software (SAS 9.1.3 Portable)to determine the effect of the independent variables on the sensory qualities of the product and to determine the optimum coconut milk, sautéing and retort time combinations was conducted. The samples for analysis were selected through randomized collection. Response surface plots were made for all analyses as reference points using STATISTICA computer program to clarify the different effects of factor variables on the responses studied.

2.5 Verification

Verification tests were conducted in duplicate using two selected treatments. Twenty-eight (28) panelists were randomly selected from the 60 that participated during the sensory acceptance test. The treatments included one within and one outside the optimum zone. A paired t-test was done to determine if the actual values was different from the predicted.

2.6 Consumer Preference Test

The treatment in the verification test that was within the optimum zone was used in the consumer preference test and was referred as the "plain" sample. The other treatment was of the same formulation but with added chopped chili (18g) and was referred as the "hot" sample. The consumers evaluated the acceptability of the products and their preference between the two treatments was determined. One hundred consumer panelists were employed consisting of adult consumers. The consumer preference test was done on the samples after 1 week of storage.

2.7 Microbial Analysis

Plate Count Agar (PCA) was used as the medium for the determination of total plate count of microorganisms on the canned *halang-halang* after 0, 3, 6, 9, 12 and 15 months of storage at room temperature. It was conducted on the "hot" *halang-halang* samples. Buffered dilution water was used as dilution blank in the preparation of serial dilution standard plating.

Standard plating procedure was followed for microbial load determination of the samples. Duplicate plates per dilution were made in order to obtain more reliable results. The plates were incubated for 3-5 days at 27ºC. Microbial growth was counted and was reported as colony forming units (CFU) per gram sample.

III. RESULTS AND DISCUSSION

3.1 Sensory Quality Characteristics of Canned *Halang-halang*

Sensory quality characteristics of canned *halang-halang* namely, color, aroma, texture, flavor and general acceptability were affected by the sautéing time, levels of coconut milk as well as the retort time used during processing.

3.1.1 Color Acceptability

The color acceptability values ranged from 5.071 to 7.571 with an overall response mean of 6.735. The conditions predicted for optimum color acceptability of 6.412 were: –6.378 minutes sautéing time, 32.910% coconut milk level, and 35.264 minutes retort time. The predicted optimum condition for sautéing time was located outside the region which was relatively smaller than the studied time; however predicted conditions for coconut milk and retort time were at higher and lower level respectively. This shows that higher coconut milk level, shorter retort time and 0 minutes sautéing time were more favorable for higher color acceptability. This might be true since higher combinations of sautéing time and retort time would destroy proteins and caramelizes sugar present in the coconut milk producing a darker brown color. The predicted maximum sensory score for color acceptability falls between *like slightly* to *like moderately*, implying that canned *halang-halang* is relatively acceptable to the consumer panel.

3.1.2 Aroma Acceptability

The aroma acceptability values for the different canned *halang-halang* samples *which* ranged from 5.821 to 7.535 had an overall response surface mean of 6.892. Statistical analysis (data not shown), revealed that the response on aroma was only affected by coconut milk level and its quadratic effects. This indicates the dependence of aroma acceptability on coconut milk level and its independence on the other variables. The conditions predicted for optimum aroma acceptability of 7.076 of the product were: 3.159 minutes sautéing time, 31.310% coconut milk level and 42.946 minutes retort time.

3.1.3 Texture Acceptability

The texture acceptability which ranged from 5.357 to 7.464 had an overall response mean of 6.623. The conditions predicted for optimum texture acceptability of 6.543 of the canned *halang-halang* were: 2.637 minutes sautéing time, 29.408% coconut milk level, and 38.455 minutes retort time. This implies that shorter sautéing time combined with mid-level of coconut milk and shorter retort time would yield higher texture acceptability scores. Such combinations may result in a product with tougher texture. The preference of tougher texture may be due to the toughness of commercially available canned chicken product and could have influenced the texture acceptability evaluation.

3.1.4 Flavor Acceptability

The flavor acceptability values of canned *halang-halang* samples ranged from 4.785 to 7.678 with an overall response mean of 6.697. Statistical analysis (data not shown) indicates that flavor response was only affected by coconut milk level and its' quadratic effects. This implies that flavor acceptability of canned *halang-halang* depends mainly on the coconut milk level. The predicted optimum condition for flavor acceptability of canned *halang-halang* was 7.06. The predicted response occurred at an optimum condition of -0.019 minutes sautéing time, 42.39% coconut milk level and 35.93 minutes retort time. The predicted optimum condition of sautéing time and coconut milk level was located outside the region which was respectively smaller and larger than the studied level; however predicted condition for retort time was at a lower level. This implies that higher flavor acceptability is achieved at 0 minute sautéing time with the highest level of coconut milk combined with lower retort time. According to Fox and McSweeney (2006), higher temperature during sterilization yields to the production of acrid flavor (hydroxymethyl furfural).

3.1.5 General Acceptability

The general acceptability of canned *halang-halang* samples ranged from 5.321 to 7.821 and had an overall response mean of 6.885. The conditions predicted for optimum general acceptability of 7.00 of the canned samples were: 4.79 minutes sautéing time, 27.63% coconut milk level and 39.55 minutes retort time. This indicated that mid level of sautéing time, coconut milk and retorting time obtained the optimum general acceptability. The predicted maximum general acceptability score falls within *like moderately* in the Hedonic scale used in the study.

3.2 Attaining the Optimum Formulation

The contour plots (Figures 1a, 1b, and 1c) represent an idea as to which combinations of sautéing time, coconut milk level and retort time could result in a product with certain acceptability level. The shaded regions represent values for consumer acceptance for a particular attribute of canned halang-halang corresponding to scores of $\geq$ 6.50, which lie within like slightly to like moderately in the 9-Point Hedonic Scale. The contour plots when overlapped showed that consumer acceptance for texture seemed to be the limiting factor during the optimization procedure. A large area satisfied the requirement of score $\geq$ 6.50. The optimum region required a combination of higher or lower retort time of approximately 50 or 30 minutes, a mid-level coconut milk (20%) at any sautéing time (0 to 6 minutes). Four treatments were within the given optimum region. The treatments from the Box-Behnken design with 0 and 6 minutes sautéing time at 20% coconut milk and 30 minutes retort time and treatments with 6 and 0 minutes sautéing time at 20% coconut milk and 50 minutes retort time from the (T_1, T_2, T_3 and T_4 respectively) satisfied the optimum region.

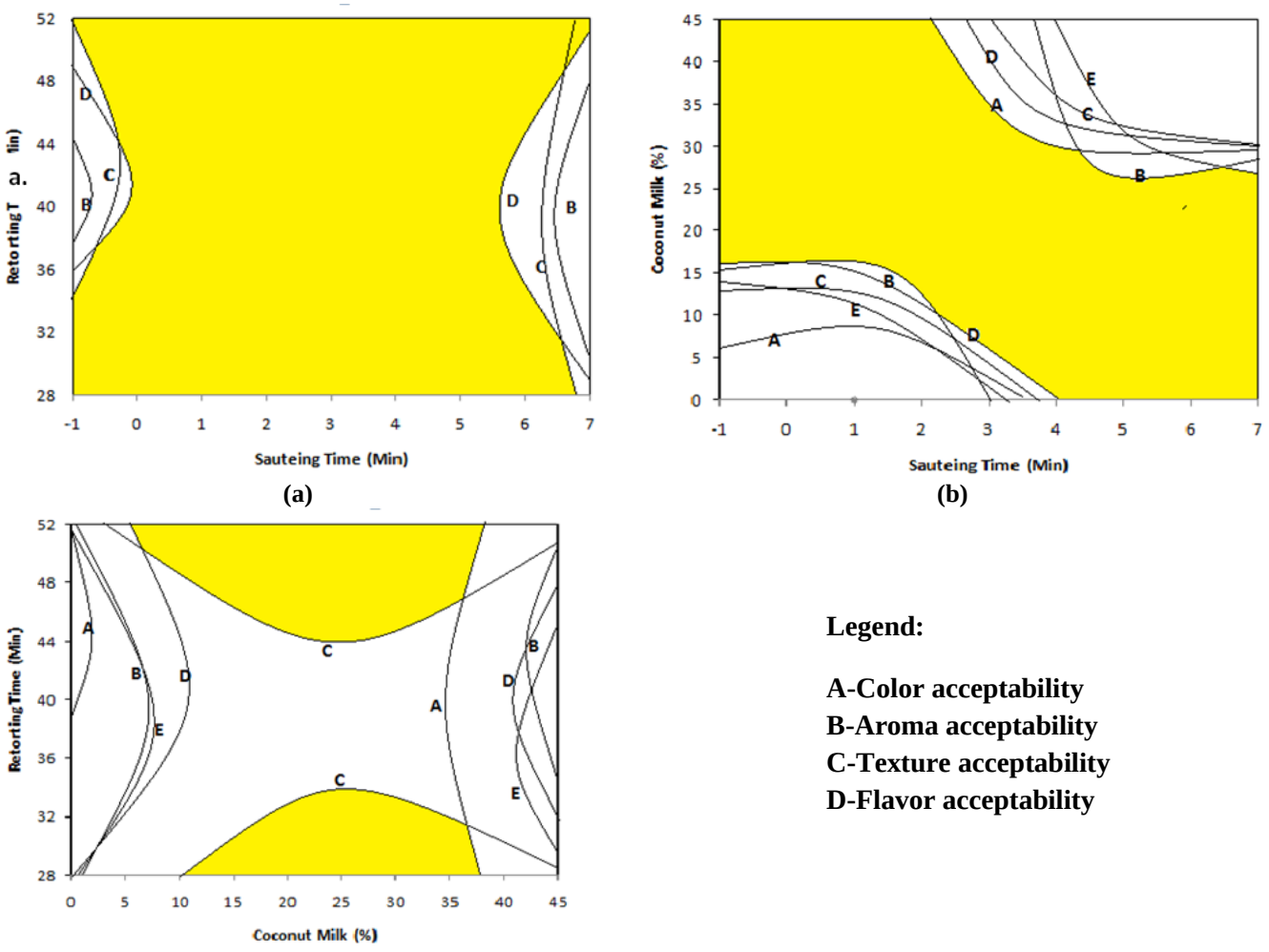

FIGURE 1: a-c. Overlapped contour plots of color, aroma, texture, flavor, and general acceptability of canned *halang-halang* as affected by the combinations of: (a) retort time and sautéing time at constant coconut milk (20%), (b) coconut milk level and sautéing time at constant retort time (50 minutes), and retort time and coconut milk level at constant sautéing time (3minutes).

3.3 Verification of the Optimized Region

Verification tests revealed the predictive ability of all models developed as shown by non-significant differences between observed and predicted values of the treatments tested at 5 % level of significance (Table 2) for all sensory qualities even that of the treatment outside the optimum region. This implies that the models used fit the regression.

TABLE 2
MEAN VALUES OF THE SENSORY QUALITIES OF THE PREDICTED AND ACTUAL OPTIMUM FORMULATION OF CANNED *HALANG-HALANG*.

Parameter	Treatment X		Treatment Y	
	Predicted	Actual	Predicted	Actual
Color	7.39 ± 0.43	7.75 ± 0.42	6.53 ± 0.57	6.21 ± 0.38
Aroma	7.39 ± 0.21	7.67 ± 0.20	7.17 ± 0.43	6.67 ± 0.39
Texture	7.46 ± 0.32	7.21 ± 0.35	6.89 ± 0.47	6.39 ± 0.42
Flavor	7.35 ± 0.38	7.46 ± 0.47	7.67 ± 0.25	7.28 ± 0.28
General Acceptability	7.25 ± 0.50	7.67 ± 0.35	7.07 ± 0.42	6.71 ± 0.23

n =28 panelists
X = treatment inside the optimum region (6 minutes sautéing time; 20% coconut milk and 50 minutes retorting time)
Y = treatment outside the optimum region (6 minutes sautéing time; 40% coconut milk and 40 minutes retorting time)

3.4 Consumer Preference Test

Canned "hot" and "plain" *halang-halang* samples were subjected to consumer preference test. The consumer preference panel was composed of mostly male respondents (85%) since they would likely be the target consumers. Sixty percent (60%) of the respondents were students and the remaining 40% were non-students.

For the "plain" *halang-halang*, 24% of the respondents extremely liked the product, 56% moderately liking the product, while only 10% disliked the product. On the other hand, for the "hot" *halang-halang*, 52% of the respondents extremely liked the product, 34% moderately liked the product, while only 9% disliked the product. This implies that the two canned *halang-halang* products were very acceptable to the consumers.

A large number of the respondents, however, preferred one product from the other. 68% of the respondents preferred the "hot" canned *halang-halang* than the plain one (32%).

3.5 Microbial Analysis

TABLE 3
STANDARD PLATE COUNTS (CFU/G) OF CANNED "HOT" *HALANG-HALANG* AT DIFFERENT STORAGE PERIODS.

	Storage Periods (Mos.)					
	0	3	6	9	12	15
Microbial counts	<10	<10	<10	<10	<10	<10

Results in Table3 show that all microbial counts from canned *halang-halang* at storage periods 0 to 15 months are all less than 10CFU/g. The number of microorganisms is below the tolerable level. Based on the specification from the center for Food Safety (2014), the safe level for microbial counts of canned products immediately after removal from container is <10. This indicates that shelf-life quality of canned *halang-halang* samples is still microbiologically acceptable after 15 months of storage.

IV. CONCLUSION

Among the three independent variables under study, both coconut milk, and retort time significantly affected the sensory qualities of the product, while sautéing time showed non-significant effects in all sensory qualities being evaluated. The optimum combination of the variables occurred at two different conditions. The first one requires a mid-level of coconut

milk (20%), high retort time (50 minutes) and at any sautéing time. The other one requires a combination of a mid-level of coconut milk (20%), lower retort time (30 minutes) and at any sautéing time. On the other hand, consumer preference test on the products revealed that 68% of the test consumers preferred the "hot" *halang-halang* variant than the "plain". The canned *halang-halang* samples were still shelf stable after 9 months of storage.

REFERENCES

[1]. Buzby, J.C and Farah, H.A. (2004). Chicken consumption continues longrun rise. *Diet and Health*. Retrieved on June 12, 2017. Retrieved from http://ageconsearch.umn.edu/bitstream/126587/2/ChickenConsumption.pdf

[2]. Center for Food Safety (2014). Microbiological guidelines for food (For ready-to-eat food in general and specific food items) Retrieved on August 08, 2017. Retrieved from http://www.cfs.gov.hk/english/food_leg/files/food_leg_Microbiological_Guidelines_for_Food_e.pdf

[3]. Espina, D.M. (1992). Carcass and Sensory Evaluation of the Meat Qualities of the Native Chicken and Some Locally Available Commercial Breed and their Upgrades. MS Thesis. ViSCA, Baybay, Leyte. 110 pp.

[4]. Fox, P.F., McSweeney, P.E.(2006). Advanced Dairy Chemistry *Volume 2: Lipids*. pp233

[5]. Labensky, S.R. and Hause, A.M. (1995). On Cooking. A textbook of culinary fundamentals. Prentice-Hall, Inc. Englewood Cliffs, New Jersey. 1080 pp.

[6]. Lai, P.K and Roy, J. (2004).Antimicrobial and Chemopreventive Properties of Herbs and Spices. Current Medicinal Chemistry. 2 (2) 1451-1460

[7]. Lasquites, J.M (2014, January 20) Personal Interview on how to process halang-halang

[8]. Meyer, R.H and D.C. Montgomery.(1995). Response surface Methodology: process and product optimization using designed experiments. John Wiley and Sons, Inc. New York, U.S.A. 91-99 pp.

[9]. Resureccion, A.V.A. (1998). Consumer Sensory Testing for Food Development, Aspen Publisher Incorporated. Gaithersburg, Maryland. 254 pp.