



RESEARCH PAPER

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Shelf-stable chevon dishes in retortable stand-up pouch

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Abstract

The study developed shelf-stable chevon dishes namely, chevon bulgogi, chevon bitter stew (*pinapaitan*), chevon in tamarind broth (*sinampalukan*) and chevon salad (*sisig*) in retortable stand-up pouch from slaughter goats. It involved standardization of formulations and processes, quality control of raw materials, in-process, and finished product characterization, heat penetration, and shelf life studies. Further, chevon dish characterization involved sensory evaluation, physicochemical, microbiological, heat penetration using water retort and shelf life tests. The chevon dishes have varied thermal process (temperature and time) schedules ranging from 121 to 121.6°C and 38 to 48 minutes. The dishes are highly acceptable to consumers. All are low-acid foods but are safe based on microbiological test results. The dishes in pouches can last up to six months for chevon bitter stew, chevon in tamarind broth and chevon salad; while 13.8 months for chevon bulgogi. These chevon dishes in convenient packages can be commercially available anytime.

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Introduction

Foods are of plant or animal origin and contain moisture, protein, lipid, carbohydrate, minerals, and other organic substances. Foods undergo spoilage due to microbial, chemical, or physical actions. Nutritional values, color, texture, and edibility of foods are susceptible to spoilage. Therefore, foods are required to be preserved to retain their quality for a longer period of time. Food preservation involves various processes or techniques primarily to increase shelf life as well as maintain the original nutritional value, color, texture and flavor of food (Amit *et al.*, 2017).

Goat meat (chevon) is a high-quality protein source. It is leaner than other red meats and its fat is less saturated (Rhee *et al.*, 2003). Chevon is considered the world's healthiest red meat (Cangao, 2010). Most Filipinos throughout the world have a soft heart for chevon delicacies like *kilawen*, *pinapaitan*, *sinampalukan*, and also *kaldereta*. These are integral to special occasions.

Researchers reported the desirability of using retortable pouches for various products such as fish curry, mussel and others (Rajkumar *et al.*, 2010). Other studies utilized goat meat and slaughtering waste or by-products. Chevon products in retortable stand-up pouches were developed as convenience foods that will be readily available to consumers craving for chevon delicacies with less expense and time for its preparation. A retort pouch is commonly defined as a flexible pouch for low-acid foods that are thermally processed in a pressure vessel, often called a "retort." The pouch is made of layered polyester, aluminum foil, and polypropylene. Commercial sterilization occurs at temperatures greater than 212 °F, typically 240 to 250 °F. The retort packaging is shelf stable at room temperature (Amit *et al.*, 2017). Chevon dishes in retort pouch are prepackaged food that can be prepared quickly and easily.

Consumer demand for high-quality convenient ready-to-eat food products is rapidly increasing and led to an increase in the commercial production of ready-to-eat products Kanatt *et al.*, 2008; Karadag & Gunes, 2008; Kakshamana *et al.*, 2013). The demand for chevon

dishes by chevon eaters, the shifting of health-conscious people from pork, beef, and chicken to chevon as protein sources, and the need for convenience foods, chevon products in thermostable pouches, encouraged the researcher to conduct this study.

The study aimed mainly to establish the process schedule and shelf life of the developed chevon dishes in retortable stand-up pouches. Specifically, it standardized the formulation and process of chevon dishes; determined the microbiological, physico-chemical, and sensory qualities of the standardized chevon dishes; and conducted heat penetration and shelf-life tests of the chevon dishes in retortable pouches.

Materials and methods

The chevon products from goat slaughter by-products and lean like chevon bitter stew (from lean trimmings), chevon in tamarind broth (from entrails), and chevon bulgogi using lean, and chevon salad from the goat's skin were formulated and standardized through sensory evaluation where descriptive and acceptability tests using trained panelists were done to determine the intensity of each sensory attributes, and process standardization. These were characterized by their physico-chemical, microbiological, process schedule, and storage qualities.

The general procedures included formulation, standardization, and sensory evaluation of chevon products using lean, entrails, and skin, physico-chemical and microbiological analyses of the standardized chevon products. Water activity, pH, and proximate composition of the developed chevon products were determined. Microbiological tests like aerobic plate count, yeast and mold count, and *Salmonella* detection were also done to check the quality of the products, and their safety for human consumption.

Heat penetration studies were conducted on chevon bitter stew, chevon in tamarind broth, chevon salad, and bulgogi, packed in retortable stand-up pouches using water retort to determine their process schedules (processing time and temperature). The test was done in a fully loaded water retort with counter pressure.

Accelerated shelf-life tests of the developed chevon products were conducted at the Packaging Technology Division of the Department of Science and Technology. Part of the shelf life study was the selection of appropriate packaging material for the chevon products in thermostable, retortable stand-up pouches.

Results and discussion

The chevon dishes from slaughter by-products like chevon bitter stew, chevon in tamarind broth, chevon bulgogi using lean, and chevon salad (*sisig*) using the skin were processed on water retort to become shelf stable with specific process schedule and storage.

Microbiological qualities of the chevon products

The different microbiological counts such as aerobic plate, yeast and mold counts of the different chevon products developed were low (<25), and did not exceed the tolerable limit in processed products (Table 1). In addition, the *Salmonella* detection is negative at 25g sample. The chevon food products are safe, nutritious, and wholesome based on good manufacturing practices as food safety measures were observed and employed during processing. These products passed the commercial sterility tests prior to shelf life studies.

Table 1. Microbiological qualities of chevon dishes.

Chevon Dishes	Aerobic plate count (cfu/g)	Yeast and mold count (cfu/g)	<i>Salmonella</i> Detection (cfu/g)
Chevon in bitter stew	<25	<10	Absent at 25g samples
Chevon in tamarind broth	<250	<10	Absent at 25g samples
Chevon bulgogi	<250	<10	Absent at 25g samples
Chevon salad	<10	<10	Absent at 25g samples

Physicochemical qualities of the chevon products developed

Water activities and pH of the developed chevon products influence their shelf life and the appropriate packaging material to protect and extend their storage life (Table 2). The chevon products in retortable pouches exhibited high water activity which can sustain the growth of bacteria. Thus, these were processed in thermostable pouches in water

retort under pressure to prevent growth of microorganisms. Also, the pH values of the chevon products fell within the range of low-acid foods which can permit the growth of microorganisms, thus appropriate process schedules (Valdez *et al.*, 2015) were determined to make the products shelf stable.

Table 2. Water activity and pH values of chevon products.

Chevon products	Water activity value	pH value*
Chevon in bitter stew	0.912	5.10
Chevon in tamarind broth	0.912	4.89
Bulgogi	0.871	5.30
Chevon salad	0.891	4.78

* > pH 4.6 are low acid foods

Sensory qualities of the developed and standardized chevon products

Sensory qualities (descriptive attributes with their intensities) of these chevon products are reflected in Tables 3, 4, 5, and 6. The chevon products in retortable stand-up pouches were developed to come up with shelf-stable chevon dishes that could be available to consumers anytime, if these will be commercialized. Desirable characteristics of the four chevon dishes were identified through descriptive analysis by trained sensory panelists or focus groups. Chevon bulgogi, a new product developed, can be eaten by non-chevon eaters since the chevon flavor is not distinct, only a meaty flavor can be perceived (Table 5).

Table 3. Descriptive attributes of developed chevon in tamarind broth.

Attributes	Mean scores	Description
Color	50	Creamy
Saltiness	61	Perceptible
Sourness	70	Moderate
Chevon flavor	116	Strong chevon flavor
Spicy flavor	11	Just perceptible
Tamarind flavor	80	Moderate tamarind flavor
Hardness	75	Moderate
Roughness	32	Smooth like orange peel
Tooth packing	10	None stuck

The four chevon products attained high acceptability when tested by the trained and consumer panelists based on the perceived attributes identified (Tables 3 - 6). The chevon bulgogi had the highest acceptability.

Moreover, the chevon salad and chevon bitter stew were preferred by male consumer panelists. The chevon flavor is present in chevon bitter stew, chevon in tamarind broth, and chevon salad.

Table 4. Descriptive attributes of the developed chevon in bitter stew (*papaitan*).

Attributes	Mean scores	Description
Color (broth)	60	Near light greenish-brown
Color (meat)	50	Near light brown
Saltiness	65	Perceptible saltiness
Sourness	80	Moderate
Spiciness	80	Moderate
Chevon flavor	65	distinct chevon flavor
<i>Papait</i> flavor	80	Moderate <i>papait</i> flavor
Bitterness	80	Moderate bitterness
Ginger flavor	75	Moderate ginger flavor
Hardness	70	Moderately soft
Roughness	85	Slightly rough
Oiliness	85	Moderately oily
Chewiness	65	slightly compact
Tooth packing	20	Slight tooth packing

Table 5. Descriptive attributes of the developed chevon bulgogi.

Attributes	Mean scores*	Description
Color	100	Brown, like cooked beef
Sweetness	50	Perceptible
Saltiness	30	Mild saltiness
Celery flavor	78	Moderate celery flavor
Sesame flavor	65	Distinct sesame flavor
Spiciness	100	Strong spiciness
Meat flavor	90	Strong meat flavor
Hardness	78	Moderately soft
Roughness	100	Moderately rough
Oiliness	21	Just perceptible oiliness
Tooth packing	10	Low tooth packing
Moisture absorption	75	Moderate moisture absorption

Table 6. Descriptive attributes of the developed chevon salad (*sisig*).

Attributes	Mean scores	Description
Color	110	Moderate brown
Saltiness	50	Perceptible
Sourness	30	Just perceptible
Sweetness	25	Just perceptible
Chevon flavor	80	Moderate chevon flavor
Garlic flavor	60	Distinct garlic flavor
Chili flavor	90	Moderate chili flavor
Hardness	80	slightly hard
Roughness	60	Slightly smooth
Oiliness	30	Just perceptible
Tooth packing	20	low tooth packing
Moisture absorption	60	Distinct moisture absorption

Heat penetration studies on the chevon products

After standardizing the formulation and process of the different chevon dishes packed in retortable pouches, these were subjected to heat penetration studies to determine the right process schedule (proper time and temperature) using water retort to attain commercial sterility (Table 7).

The process schedule must be followed during the production of these products to come up with shelf-stable and wholesome products.

In the process schedule, the chevon bulgogi required a longer time and slightly higher temperature than the other dishes since the material used is pure chevon lean and has less liquid. The chevon in bitter stew dish also demands a longer processing time (Riviezzi *et al.*, 2005) than chevon salad and chevon in tamarind broth (Valdez *et al.*, 2015) because of the nature of the raw material such as entrails and other internal organs that need proper cooking.

Table 7. Calculated processing schedule for chevon dishes at F_0 value of 6.0 minutes.

Chevon Dish	Time (minutes)	Temperature (°C)
Chevon in bitter stew	41	121.0
Chevon in tamarind broth	39	121.0
Bulgogi	48	121.6
Chevon salad	38	121.0

Shelf life studies of chevon products

The shelf life studies of the chevon dishes in retortable pouches were conducted and there are requirements needed prior to shelf life tests like water retort processing of the products packed in retortable stand-up pouch, and commercial sterility test for two weeks. The chevon products passed these tests based on the different quality tests. These processed foods are usually stored at room temperature and should undergo shelf-life test for the safety of consumers (Magari *et al.*, 2003; Meilgaard & Carr, 2007).

Table 8 shows the calculated shelf life of the chevon dishes packed and processed in retortable pouch. This was done through an accelerated shelf life study based on different quality tests like rancidity,

microbiological, and physico-chemical tests. The chevon bulgogi can be shelf stable for 13.8 months. The ingredients added to the dish like sugar contributed to its shelf stability. The other dishes like chevon bitter stew, chevon in tamarind broth, and chevon salad had shorter shelf life in retort pouch, a thermostable laminate.

The chevon dishes processed in retort pouch were properly labeled. These products were submitted and registered for patent as utility models.

Table 8. Calculated shelf life of chevon dishes packed in retortable pouch stored at room temperature.

Chevon Dishes	Shelf life (months)
Chevon in bitter stew (<i>pinapaitanan</i>)	6.0
Chevon in tamarind broth (<i>sinampalukan</i>)	6.0
Bulgogi	13.8
Chevon salad (<i>sisig</i>)	5.0

Conclusions

Chevon dishes developed using lean, skin, trimmings, and entrails from slaughter goat can be shelf-stable when packed in retortable stand-up pouches and processed properly under pressure in water retort. These chevon dishes have acceptable descriptive and acceptability attributes, and their low microbial loads imply safe and hygienic good manufacturing practices observed during processing. Moreover, the technology for the chevon dishes in retort pouches can be transferred to possible takers for commercialization after the pilot scale and market testing since these are patented as Utility Models.

Statement of conflict of interest

The author declares that there is no conflict of interest.

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