

INCIDENCE OF SPOILAGE OF VACUUM - PACKAGED IN REFRIGERATED AND FROZEN CHICKEN MEAT PRODUCTS

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Abstract: *The study aims to indicate the characteristics of spoilage of vacuum - packaged in refrigerated and frozen fresh chicken meat products. The proteolytic enzymes (exocellular and endocellular) of Enterobacteriaceae cells were able to break down protein and sulfur-containing amino acids to produce H₂S associated with egg odor in vacuum - packaged in refrigerated fresh chicken meat product. During frozen storage of the marinated products were loose and the thawed meat had off-flavor, which was distinct in the 100 days stored products. The results revealed the unmarinated product had low levels of the four bacterial groups tested. In the 100 days frozen stored products, the counts of all four bacterial groups tested dropped by 2 to 3 log cycles.*

Key words: *Psychrotrophs, Enterobacteriaceae, chicken meat products, storage*

Introduction

The major factors that can be attributed to the increase demand for refrigerated food are: the increasing need of the consumers for convenient foods, increase in awareness that harshly processed and preserved foods are not beneficial for a healthy life, the technologies used for economical production and subsequent handling are available in developed countries, the consumers perceive to be better taste, texture, quality and convenience and relatively fresh, nutritious, close to natural, as compared to frozen, canned or dried and fast foods.

New generation foods are processed by low-heat treatment to no heat treatment, contain low content or no preservatives, many are vacuum packaged or packaged with (MA) modified atmosphere – 100% CO₂ or a mixture of CO₂ and nitrogen without or with some oxygen, are expected to have more than 50-days shelf life.

Psychrotrophs are mesophilic subgroup capable of growing at 4,4°C or below and include both the mesophile subgroup and

psychrophiles. Data on the incidence of contamination of vacuum- and modified-air-packaged foods revealed **mesophilic pathogens** – *Yersinia enterocolitica* and *Listeria monocytogenes*; **spoilage bacteria** – *Leuconostoc* spp, several *Lactobacillus* spp. and *Serratia* spp. with growth range between 0 and 1°C; **psychrophilic** *Clostridium* spp. with growth range between -2 and 20°C.

Experimental

The first experiment – Changes in Refrigerated Chicken Meat Product during Storage

Skinless and boneless chicken breast meat diced and marinated in mixture with 1,2% salt and 1,8% Na-lactate, vacuum-packaged and stored at 6°C, pH of the sample was 6 – 6,2.

Duplicate samples were analyzed after 4 days and after 24 days (gas or exudates accumulation, odor, pH). Were enumerated the following groups: aerobic plate counts, psychrotrophic counts, lactic acid bacteria, coliforms, *Enterobacteriaceae*.

The second experiment – Changes in Frozen Chicken Meat Product during Storage

- unmarinated, vacuum-packaged and frozen to -20°C , stored for 7 days;
- marinated, vacuum-packaged and frozen to -20°C , stored for 25 and 100 days;

PH of the samples was 6,3.

Duplicate samples were analyzed after 7 days, 25 days and after 100 days. Were enumerated the following groups: aerobic plate counts; psychrotrophic counts; coliforms; *Enterobacteriaceae*.

Results and discussions

The first experiment – Changes in Refrigerated Chicken Meat Product during Storage

Skinless and boneless chicken breast meat was diced and marinated (the mixture contained different ingredients including 1.2% salt and 1.8% Na-lactate), vacuum-packaged, and stored at 6°C . The pH of the product was 6.0 to 6.2. Within 7 days the products developed mild egg odor that increased in intensity during expected storage life of 28 days.

The vacuum-packaged samples (4 days and 24 days old) were received in ice pack container and analyzed within 24 h. Duplicate samples were tested for each group. There was no gas or exudates accumulation in the bags, but in the 24 days old samples the bags were slightly

Skinless and boneless chicken thigh meat diced and marinated in mixture with 1,8% salt and 3% Na-lactate, in two ways:

loose. Following opening, the fresh samples had chicken odor, but the old samples had distinct egg odor and were positive for the presence of H_2S (tested with lead acetate). PH of both groups of product was 6.0. The bacterial groups enumerated were: aerobic plate counts (APC 35°C for 2 days), psychrotrophic counts (10°C for 7 days), both with plate count agar; lactic acid bacteria (35°C for 2 days) in MRS-agar (adjusted to pH 5.0); coliforms (35°C for 1 days) in violet red bile agar; and *Enterobacteriaceae* (35°C for 2 days) in violet red bile glucose agar media. Aliquotes from appropriate dilutions were pour-plate using duplicate plates in each dilution.

The results (Table 1) revealed that in 4 days old products the levels of five bacterial groups were not unexpectedly high for a diced meat product. Similar levels for APC were also obtained in 1 day old products tested in the processor's laboratory. After 24 days at 6°C , both APC and psychrotroph counts increased but remained below the usually accepted spoilage detection level (about $\geq 10^7/\text{g}$). However, the levels of coliforms and *Enterobacteriaceae* decreased during storage. The fresh samples had about $6 \times 10^2/\text{g}$ *Proteus*, but the 24 days old samples did not have any in 10^{-1} dilution.

Table 1. Change in cfu/g of several bacterial groups in refrigerated chicken meat product during storage

Bacterial groups	cfu/g ^a	
	Fresh (4 days) ^b	Old (24 days)
Aerobic plate count	5.9×10^4	5.8×10^5
Lactic acid bacteria	4.9×10^4	3.5×10^4
Psychrotrophic bacteria	7.0×10^4	4.5×10^5
Coliforms	4.0×10^3	7.0×10^2
<i>Enterobacteriaceae</i>	5.6×10^3	1.5×10^2

^a Average of 2 samples.
^b Fresh samples, but not the old samples, had about 6×10^2 *Proteus*.

Conclusions - first experiment

The levels of coliforms and *Enterobacteriaceae* decreased during combined action of 1.8% lactate, 1.2% salt, and 6°C. Their proteolytic enzymes (exocellular and endocellular) were able to break down protein and sulfur-containing amino acids to produce H₂S associated with egg odor. To overcome such problems an important objective will be to keep the level of *Enterobacteriaceae*, as well as the level of Gram-negative bacteria, very low.

Results and discussion

The second experiment – Changes in Frozen Chicken Meat Product during Storage

Skinless and boneless chicken thigh meat was diced and marinated (the mixture contained different ingredients with 3% Na-lactate and 1.8% salt). The products (pH 6.3) were vacuum packaged and frozen to -20°C. The product, expected to

storage. It was suspected that cells of *Enterobacteriaceae*, including *Proteus* sp., were killed during storage by the have 90 days or more shelf life, is thawed by customers just before use. When thawed during storage the products gave an off-odor, which increased in intensity with storage period.

Vacuum-packaged meat samples consisting of frozen unmarinated and marinated and frozen stored for 25 days and 100 days were enumerated for the levels of several bacterial groups. The packages of the marinated products were loose and the thawed meat had off-flavor, which was distinct in the 100 days stored products.

The results (Table 2) revealed the unmarinated product had low levels of four bacterial groups. In the 100 days stored products, the counts of all four bacterial groups dropped by 2 to 3 log cycles.

Table 2. Change in cfu/g of several bacterial groups in frozen chicken meat product during storage

Meat types	Days at -20°C	cfu/g ^a			
		APC	Psychrotrophs	Coliforms	<i>Enterobacteriaceae</i>
Unprocessed	7	1 x 10 ⁴	3 x 10 ⁴	5 x 10 ¹	2.8 x 10 ³
Processed	25	1 x 10 ⁷	1.9 x 10 ⁷	1.1 x 10 ⁴	1 x 10 ⁵
Processed	100	4 x 10 ⁴	3.2 x 10 ⁴	1.4 x 10 ²	1.1 x 10 ²

^a Average of 2 or more samples.

Conclusions - second experiment

The results revealed the unmarinated product had low levels of four bacterial groups.

It was suspected that the unmarinated product was heavily contaminated during the process involving marination. Many of these were Gram-negatives (psychrotrophs, coliforms, *Enterobacteriaceae*). During frozen storage, in the presence of high lactate and salts, many of them were killed. Some of their enzymes were able to catalyze reactions slowly at -20°C and cause slight proteolysis (and maybe lipolysis), producing flavor compounds that could be identified following thawing

of meat. In order to overcome the problem it will be important to adopt good sanitary practices and proper temperature control during processing and prior to freezing of the product.

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