

**INFLUENCE OF PACKAGING CONDITIONS ON THE PHYSICALLY – CHEMICAL
PARAMETERS OF VENISON PICKLED IN MAYONNAISE MARINADE**

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Abstract

Venison due to the muscle lower fat content has gained an increase in popularity in recent years. Venison is lower in calories, cholesterol and fat content than common cuts of beef, pork or lamb. The objective of the present study was to determine quality parameters: pH (LVS ISO 5542:2010), moisture (ISO 1442-1997), fat (LVS ISO 2446:1976) and protein (Kjeldahl nitrogen, AN 3002) content dynamics in mayonnaise marinade pickled venison and beef (for comparison) during storage. The meat (2x3x2 cm) pieces were pickled in mayonnaise marinade (composition: mayonnaise, onion, parsley, paprika, basil, black pepper, rosemary, salt) at 4±2 °C temperature for 48±1 h. Marinated meat was placed in polypropylene trays, hermetically sealed with high barrier polymer film under modified atmosphere (CO₂ 40%+N₂ 60%) exclusively, as well as placing in packages iron based oxygen scavenger sachets (Mitsubishi Gas Chemical Europe Ageless®). As a control packaging in air ambience was used. During storage time (14 – 18 days) pH, moisture and protein content of both investigated meat samples decreased. Considerably the reduction of mentioned parameters was observed in air ambience packed venison samples.

Key words: *venison, marinating, modified atmospheres, oxygen scavenger, storage time*

1. INTRODUCTION

Venison (deer meat) has several attributes attractive to consumers – it is tender, has low fat content, a favourable fat composition and high levels of minerals (Wiklund et.al., 2010). Venison is lower in calories, cholesterol and fat content than common cuts of pork, beef or lamb. All these properties are reason why venison has enjoyed a rise in popularity in recent years. Venison can be eaten as steaks, roasts, sausages and round meat (Dahlan and Norfarizan-Hanoon, 2008). However, venison is a highly perishable product with a short shelf life. In scientific literature describe investigation for venison shelf life extending using conservation meat in modified atmospheres (Vergara et.al., 2003), frozen venison packaging using vacuum- and nonvacuum-package (Farouk and Freke, 2008).

Marination is an effective means of enhancing the quality and versatility of meats (Kargiotou et.al., 2011). Marinating is the process of soaking foods in a seasoned, often acidic liquid before cooking. The origins of the word respond to the use of brine (*aqua marina*) in the pickling process, which led to the technique of adding flavour by immersion in liquid (Ergezer and Gokce, 2011). This process may be positively affected the shelf life of the meat due to the acidic or alkaline nature of the solution, and the antimicrobial and antioxidant activity of some marinade additives (Karigiotou et.al., 2011). A good marinade will have a delicate balance of spices, acids and oil. It is generally not recommended that raw marinated meats be frozen, as the marinade can break down the surface and make the outer layer turn mushy (Ergezer and Gokce, 2011). Also, sodium chloride, polyphosphates and sugar are considered important ingredients of marinades and they improve meat tenderness and flavour.

Packaging technology which modifies the atmospheric conditions of the package is popularly applied to extend the self-life of meat (Daszkiewicz et.al., 2011). Modified atmosphere packaging (MAP)

technology is one of the protection methods in which the surrounding atmosphere of the food is changed. Basic process in MAP is to remove the air inside the package and put in a gas or gas combination instead, and then seal hermetically (Gokoglu et.al., 2011). For venison preservation gas composition (CO_2 40%+ N_2 60%) is the most appropriate (Vergara et.al., 2003). But modified atmosphere packaging technologies not always completely remove oxygen and oxygen penetrates through the packaging film. Using oxygen scavengers can reduce oxygen level in package. Oxygen scavengers are made from easily oxidisable substances (Brandon, 2009).

The objective of the present study was to determine quality parameters: pH, moisture, fat and protein content dynamics in mayonnaise marinade pickled venison and beef (for comparison) during storage.

2. MATERIALS AND METHODS

Experiments were carried out at the Department of Food Technology, Latvia University of Agriculture in 2011. The meat of farmed red deer (*Cervus elaphus*) were obtained from a local farm "Saulstari 1", located in Sigulda region, in Latvia; the meat of farmed cattle (*Colloquially cows*) from Ltd. "Kebeco" located in Jekabpils region, Latvia.

Mayonnaise marinade (composition: mayonnaise, onion, parsley, paprika, basil, black pepper, rosemary, salt) was used for meat pickling.

Meat marinating included the following steps:

- 1) *Longissimus dorsi* muscle from venison and beef saddle cuts were manually divided in 0.250 ± 0.002 kg pieces by knife;
- 2) pieces of *Longissimus dorsi* muscle were packaged in plastic bags and labelled;
- 3) the packaged meat samples were stored in freezer at -20 ± 2 °C temperature for two weeks;
- 4) meat samples before marinating were defrosted at 4 ± 2 °C temperature in the refrigerator for 24 ± 1 h;
- 5) after defrosting meat was divided into pieces of size $2 \times 3 \times 2$ cm and mayonnaise marinade was added;
- 6) prepared samples were marinated at 4 ± 2 °C temperature in the refrigerator for 48 ± 1 h.

Marinated meat was placed in polypropylene (PP) trays (210x148x35 mm), hermetically sealed with high barrier polymer film Multibarrier 60 (composition: APA/TIE/PA/EVOH/PA/TIE/PE/PE; thickness 60 ± 2 µm) under modified atmosphere (CO_2 40%+ N_2 60%) exclusively, as well as placing in packages iron based oxygen scavenger sachets (Mitsubishi Gas Chemical Europe Ageless®). As a control packaging in air ambience was used. Meat samples were analysed at 0, 4, 7, 11, 14 and 18 (beef) days of storage in MAP. Samples remained in chilled storage at 4 ± 2 °C during this time.

The following variables were assessed:

- pH, measured using JENWAY 3520 (Barloworld Scientific Ltd., ESSEX, UK) pH-meter. The pH electrode was dipped into a mixture of homogenized sample and distilled water (1:10) (LVS ISO 5542:2010);
- moisture content (ISO 1442-1997);
- fat content (LVS ISO 2446:1976);
- protein content was determined according to the Kjeldahl nitrogen method (AN 3002).

The data were processed by one-way analysis of variance (ANOVA) in order to determine the effect of packaging condition and storage time on each variable. The level of statistical significance was $p < 0.05$.

3. RESULTS AND DISCUSSION

The quality parameters: pH, moisture, fat and protein content dynamics of pickled in mayonnaise marinade venison and beef during storage are shown in Table 1 and Table 2. Mentioned parameters were not determined in venison samples packaged in air ambience after 11 and 14 days due to the organoleptical properties inadequacy as flavor.

Table 1. Effects of packaging and storage time on pH, moisture, protein and fat values of pickled venison¹.

Parameter	Packaging ²	Storage days				
		0	4	7	11	14
pH	A	5.56±0.01	5.54±0.06	5.49±0.02	-	-
	B	5.56±0.01	5.55±0.01	5.45±0.02	5.42±0.05	5.32±0.01
	C	5.56±0.01	5.55±0.01	5.46±0.03	5.31±0.03	5.37±0.00
Moisture, %	A	70.61±0.45	68.25±1.44	67.64±0.31	-	-
	B	70.61±0.45	69.50±1.18	68.90±0.15	68.17±0.48	68.31±0.44
	C	70.61±0.45	69.93±0.75	69.77±0.16	69.03±0.07	69.35±0.50
Fat, %	A	4.18±0.38	5.12±2.00	5.12±0.02	-	-
	B	4.18±0.38	5.23±0.25	5.23±1.18	5.24±0.31	5.23±0.03
	C	4.18±0.38	5.30±0.39	5.30±0.42	5.30±0.08	5.31±0.32
Protein, %	A	20.67±0.26	20.47±0.26	19.91±0.14	-	-
	B	20.67±0.26	20.00±0.13	19.99±0.12	19.55±0.15	19.73±0.02
	C	20.67±0.26	20.51±0.11	20.02±0.14	19.06±0.18	19.58±0.42

-, not analysed.

¹All values reflect mean ± standard deviation.

²A=air; B= CO₂ 40%+N₂ 60% (without (-) oxygen scavenger); C= CO₂ 40%+N₂ 60% (with (+) oxygen scavenger).

Table 2. Effects of packaging and storage time on pH, moisture, protein and fat values of pickled beef¹.

Parameter	Packaging ²	Storage days					
		0	4	7	11	14	18
pH	A	5.52±0.02	5.46±0.00	5.28±0.01	5.30±0.01	5.26±0.01	5.18±0.01
	B	5.52±0.02	5.46±0.01	5.30±0.01	5.19±0.01	5.01±0.00	4.99±0.01
	C	5.52±0.02	5.38±0.02	5.30±0.03	5.14±0.00	5.00±0.00	5.01±0.00
Moisture, %	A	69.15±0.69	68.33±0.17	67.43±1.08	67.22±0.47	66.89±0.16	66.60±0.24
	B	69.15±0.69	68.61±0.71	67.20±0.94	66.73±1.33	66.01±2.34	65.64±0.27
	C	69.15±0.69	69.74±0.91	68.81±1.14	67.38±0.39	64.85±1.17	65.12±0.38
Fat, %	A	4.45±1.57	4.65±2.32	4.66±0.08	4.66±0.81	4.67±0.36	4.67±0.84
	B	4.45±1.57	4.92±1.94	4.92±1.21	4.93±0.46	4.93±1.57	4.93±0.82
	C	4.45±1.57	5.22±2.42	5.23±1.05	5.23±0.31	5.23±1.66	5.24±1.16
Protein, %	A	21.35±0.73	21.32±0.56	20.57±0.41	20.55±0.01	20.12±0.18	20.21±0.58
	B	21.35±0.73	21.60±0.10	21.11±0.89	20.71±0.09	20.29±0.54	19.50±0.05
	C	21.35±0.73	20.99±0.41	20.90±0.21	20.52±0.21	20.34±0.10	19.79±0.25

¹All values reflect mean ± standard deviation.

²A=air; B= CO₂ 40%+N₂ 60% (without (-) oxygen scavenger); C= CO₂ 40%+N₂ 60% (with (+) oxygen scavenger).

3.1. pH

The conducted experiment did not indicate significant differences ($p>0.05$) between the mean pH values of venison packaged in air ambience and under MA with/without an oxygen scavenger. Mean pH values of beef packaged in air and modified atmosphere with/without oxygen scavenger significantly different ($p<0.05$). During storage pH values decreased. Such results are very similar to in scientific literature found as Daszkiewicz et al., 2011 and Kargiotou et al., 2011. The average pH value of meat was lower after 14 days (venison) and after 18 days (beef) storage. The decrease in the pH values of meat aged for 14 and 18 days was probably caused by the growth of lactic acid bacteria and increased lactic acid concentration (Fernández-López et al., 2008). Lower pH values were found in the samples packed under CO₂ 40%+N₂ 60% atmosphere (without oxygen scavenger) than the samples packed in air ambience and under CO₂ 40%+N₂ 60% (with oxygen scavenger) atmosphere

(Table 1, Table 2). pH values changes of pickled in mayonnaise marinade venison and beef during storage are shown on Fig.1.

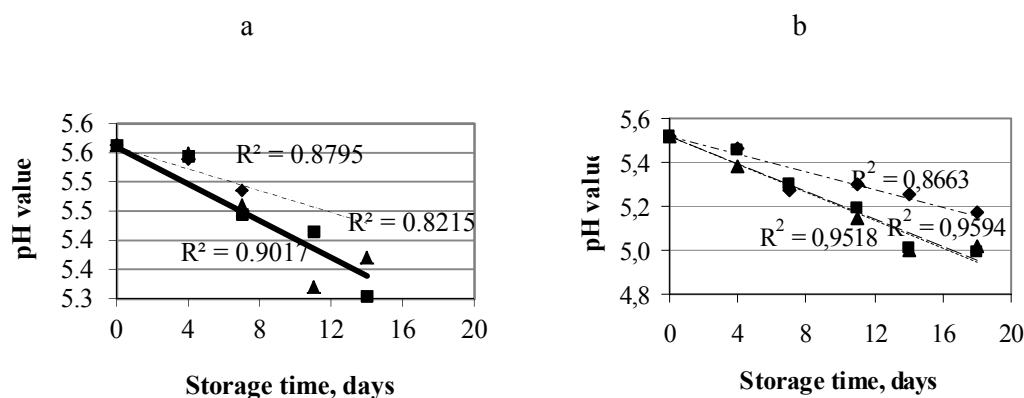


Fig.1. pH values changes of pickled in mayonnaise marinade venison (a) and beef (b) during storage.

◆: air ambience; ■: CO₂ 40%+N₂ 60% (without (-) oxygen scavenger); ▲: CO₂ 40%+N₂ 60% (with (+) oxygen scavenger).

3.2. Moisture

The results of the present study did not point to significant variations ($p > 0.05$) in moisture content in air ambience-packaged venison and venison stored in MA with/without an oxygen scavenger. Significant differences were observed ($p < 0.05$) in moisture content among in air and under modified atmosphere with/without oxygen scavenger packaging beef. However, moisture content decreased of both investigated meat samples during storage irrespective of the packaging method. Less moisture loss during storage observed in meat samples packed in air (beef) and under CO₂ 40%+N₂ 60% (with oxygen scavenger) atmosphere (venison) (Table 1 and Table 2). Moisture decrease mainly was influenced by protein denaturation during storage. Protein change their hydrophilic properties and water released from meat. Moisture content changes of pickled in mayonnaise marinade venison and beef during storage are shown on Fig.1.

3.3. Fat

During the storage of meat, a significant differences ($p < 0.05$) was observed in fat content among in air ambience-packaged meat and meat stored in MA with/without oxygen scavenger. Fat content was only quality parameter increased throughout the entire period of storage of pickled meat packaged in air and MA (Table 1 and Table 2). The increasing in fat content of package venison (4.18-5.31) was higher than package beef (4.45-5.24). Initial fat content of venison was 0.84% (beef 0.55%). After marinating fat content increase until 4.18% (venison) and 4.45% (beef). Such results could be explained by the fact that fat from mayonnaise overpass to meat. This process will continue first four storage days. After four day storage there was not found main differences in fat content. Fat content changes of pickled in mayonnaise marinade venison and beef during storage are shown on Fig.2.

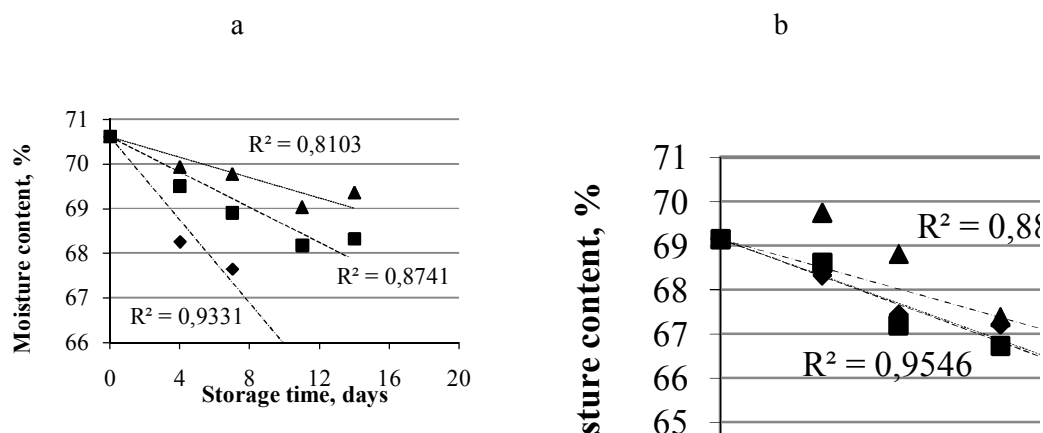


Fig.2. Moisture content changes of pickled in mayonnaise marinade venison (a) and beef (b) during storage.

♦: air ambience; ■: CO₂ 40%+N₂ 60% (without (-) oxygen scavenger); ▲: CO₂ 40%+N₂ 60% (with (+) oxygen scavenger).

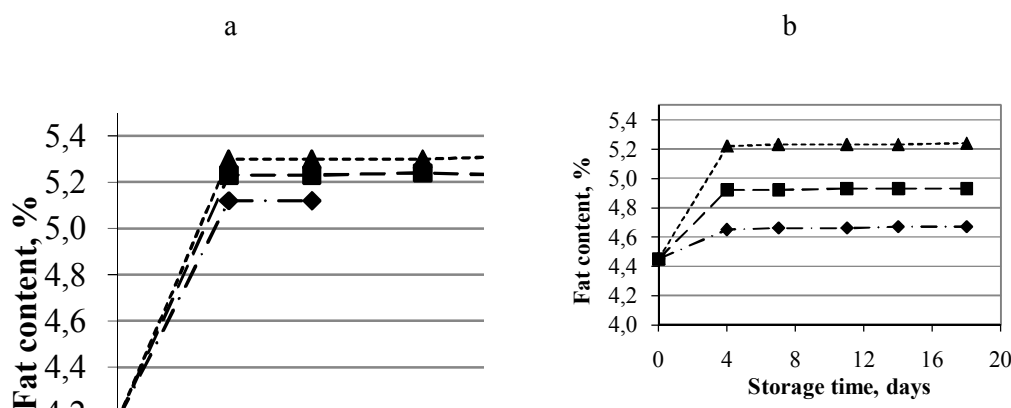


Fig.2. Fat content changes of pickled in mayonnaise marinade venison (a) and beef (b) during storage.

♦: air ambience; ■: CO₂ 40%+N₂ 60% (without (-) oxygen scavenger); ▲: CO₂ 40%+N₂ 60% (with (+) oxygen scavenger);

3.4. Protein

In the present research was found significant differences ($p < 0.05$) in protein content among in air packed meat and meat packed under CO₂ 40%+N₂ 60% atmosphere with/without an oxygen scavenger (Table 1 and Table 2). During storage protein content in both investigated meat samples decrease. Slow decline protein content of venison package under MA with an oxygen scavenger and beef package in air. One of the reasons of protein content decrease could be explained with un-adventitious microflora growing within meat storage as a result protein was divided. Protein content changes of pickled in mayonnaise marinade venison and beef during storage are shown on Fig.3.

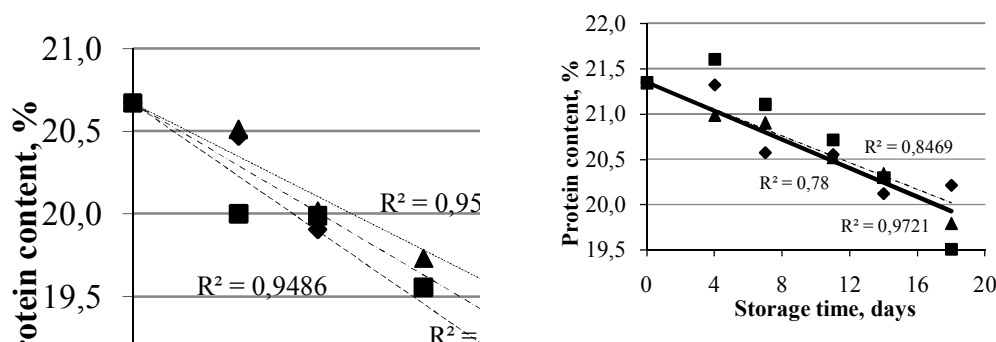


Fig.3. Protein content changes of pickled in mayonnaise marinade venison (a) and beef (b) during storage. ♦: air ambience; ■: CO₂ 40%+N₂ 60% (without (-) oxygen scavenger); ▲: CO₂ 40%+N₂ 60% (with (+) oxygen scavenger).

4. CONCLUSIONS

With this study we have observed the dynamics of the some of main parameters that affected deer meat and beef (for comparison) quality pH, moisture, fat and protein content package in air and modified atmosphere (CO₂ 40%+N₂ 60%) with/without oxygen scavenger.

Significant changes in pH value, moisture, fat and protein content were determined among air and under modified atmosphere with/without oxygen scavenger packaged beef.

Significant differences in pH value and moisture content in analysed venison samples among packages were not found. However, slower quality parameters changes were observed of venison packed under modified atmosphere with oxygen scavenger.

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