# PHYSICAL-CHEMICAL EVALUATION OF *SOUS VIDE* COOKED PARENT STOCK HEN BREAST MEAT DURING REFRIGERATED STORAGE

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**Abstract.** The aim of this study was to evaluate physical and chemical changes in *sous vide* cooked marinated parent stock hen breast meat during refrigerated storage.
*Sous vide* method is suitable for preparation of ready-to-eat meat products satisfying consumer demand for convenience and safety. Meat tenderness is recognized as important quality attribute of meats.
The study involved preparation of the raw material, vacuum packaging of the products in polyamide/polyethylene (PA/PE) film pouches, marinating for 20 hours, *sous vide* cooking and chilling in ice water, followed by storage at 3.0±0.5 °C. Each sample containing a chicken portion or chicken mix with shredded carrots, sea buckthorn sauce and spices was analysed during storage. Water activity, pH, and moisture were assessed during storage. Hardness (shear force) measurement was used as an instrumental method for meat tenderness evaluation. The differences between two studied products were noted regarding all studied parameters – water activity, pH, moisture content, and hardness. The differences mainly were determined by the properties of carrot and sea buckthorn additive, which generally have higher moisture content and lower pH. The researched parameters were well preserved during refrigerated storage for 28 days.
**Key words:** *sous vide* cooking, hen breast, hardness, storage.

## Introduction

Convenience, improved eating qualities such as tenderness, juiciness, and flavour along with safety and prolonged shelf life have important impact on the consumers' overall judgement of the food product. Extended shelf-life cook-chill foods offer a solution to conflicting requirements - they allow minimal heating to preserve freshness and extended shelf-life suitable for a production line approach (Rodgers, 2003). Vacuum cooking developed in France in the mid - 1970s called – *sous vide* processing which includes vacuum packaging food before applying low (below 100 °C) temperature thermal processing and storing under chill conditions (0 – 3 °C) is considered to offer enhanced quality and extended shelf life (Creed and Reeve, 1998; Armstrong and McIlveen, 2000).

It is widely recognized that meat tenderness is the most significant factor in consumers' satisfaction (Barbanti and Pasquini, 2005; Kong et al., 2008). The improvement of tenderness in meats is mainly caused by changes in structure of connective tissues solubilised by heat, while at the same time heat-denaturation of myofiblrillar proteins generally causes meats toughening (Palka and Daun, 1999). Marinating is a traditional culinary technique that increases water binding capacity of meats thus reducing cooking losses, tenderizing meat and improving juiciness (Brabanti and Pasquini, 2005; Froning and Sackett, 1985; Quiao, 2002).

The aim of this study was to evaluate physical and chemical changes in *sous vide* cooked marinated parent stock hen breast meat during refrigerated storage.

## Materials and Methods

Parent stock hen fillets of the cross Ross 308 were used for the study. The average age of slaughtered parent stock hens was 60 weeks; an average carcass weight of a bird was 3.1±0.5 kg. The slaughter and primary treatment was performed at a meat processing plant (line Stork PMT). Parent stock hens were stunned, then killed with a knife, bled for 3.37 minutes and scalded in a steam bath at 60.2±0.2 °C for 3.47 minutes, defeathered, eviscered, and chilled for 100 minutes at 1±0.5 °C. Three carcasses were randomly selected for separating a fillet *[musculus pectoralis]* 1.5 hours after *post-mortem*. The obtained products were packed in polyethylene bags and refrigerated at the temperature of 1±0.5 °C for 24 hours prior to *sous vide* cooking.

Two types of *sous vide* cooked poultry meat products were studied: hen breast fillets marinated in species and wine, and hen breast fillets with shredded carrots in sea buckthorn sauce and spice-wine marinade. Each sample containing chicken portion in size of approximately130 grams and mix of various vegetables, fruits and/or spices was vacuum packed and sealed in a chamber type machine MULTIVAC A 300/16 in polyamide/polyethylene (PA/PE) film pouches (size of 200x300 mm, film thickness – 60 μm) with barrier properties. Prepared samples were marinated for 20 hours, followed by *sous vide* cooking in a water bath "Clifton Food Range". After heat treatment the samples were chilled in ice water and stored at 3.0±0.5 °C.

The following parameters were analysed at the Faculty of Food Technology of the Latvia University of Agriculture on the $0^{th}$, $7^{th}$, $10^{th}$, $14^{th}$, $21^{st}$ and $28^{th}$ day of storage in triplicates for two randomly selected samples:

- moisture content - by method LVS ISO 1442:1997;
- water activity (AquaLab Lite, Decagon Inc, ASV);
- pH – using 3510pH Meter – JENWAY (Barloworld Scientific Ltd., Essex, UK);
- hardness – by TA.XT.Plus Texture Analyser (Stable Microsystems Ltd., Surrey, England) and software Texture Exponent 32.

For calibration the verification of water activity meter AquaLab Lite a standard $a_w$ 0.984±0.003 KCl 0.5 molal solution was used. The sample for water activity measurement was homogenized prior to measurement. Approximately 2±0.05 g of a homogenized product were placed in a measuring chamber. Analyses were performed in triplicates.

Approximately 50 g of the product were homogenized, and 5 g of the obtained sample was weight in a glass container, adding 50 ml of distilled water for pH measurement. Presented results are the average of triplicate measurement.

The hardness of cooked chicken was determined by the Stable Miro Systems TA.XTplus Texture Analyser with load cell of 50 kg. Samples prior to test were divided in a size to fit on a platform, then positioned under the knife blade to assure cut along the meat fibres. The test speed of knife blade was set at 2 mm $s^{-1}$. The measurement was triggered automatically at 0.05 N. The maximum force required for sample compression was calculated as an average of 10 measurements.

**Results and Discussion**

The changes in water activity in the hen fillet *[musculus pectoralis]* were observed during refrigerated storage and are presented in Fig. 1.

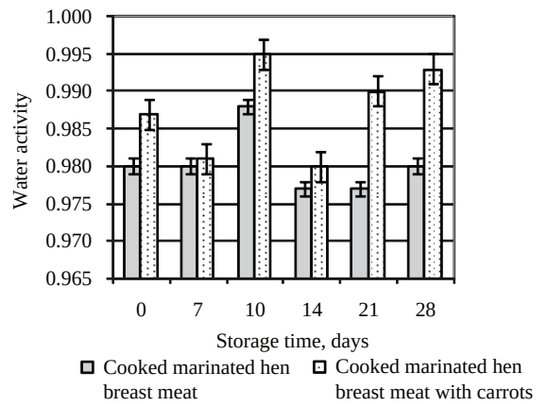



Figure 1. Water activity in cooked marinated hen breast meat without and with carrots.

A comparatively higher water activity was observed in cooked marinated hen breast meat with carrots. At the beginning of the experiment, before the storage of *sous vide* cooked products, water activity in the sample with carrots was by 0.7% higher compared to the sample without carrots, but after 28 days of storage it was by 1.3% higher. It can be explained by higher water activity of cooked carrots and sea buckthorn sauce being added in the sample. This may cause more rapid spoilage of the product although reduced pH 5.2 – 5.5 of the sample due to the added ingredients may have protective impact. When *sous vide* cooking is used, the shelf life is significantly longer compared to the traditional cook-chill technology. Generally, cook-chill products are 'unprotected' having high $a_w$ and pH, low salt content, and no preservatives (Rodgers, 2003).

The tendency of slight increase in water activity was noted by the end of the researched storage period. The product containing carrots did not show consistent measurements during the storage time – at the beginning there was a slight decrease which was followed by an increase.

The pH value in the hen fillet *[musculus pectoralis]* was observed during refrigerated storage and is presented in Fig. 2.

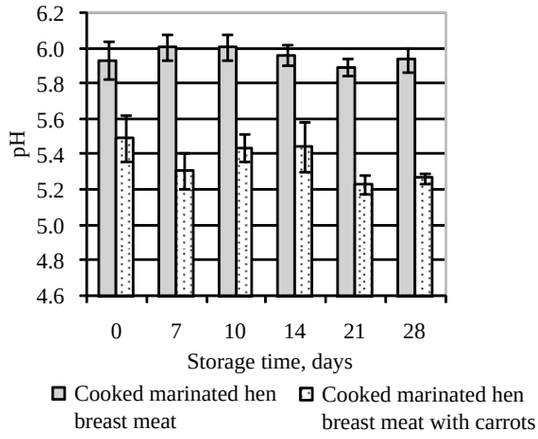



Figure 2. pH comparison between cooked marinated hen breast meat without and with carrots.

In pH in raw marinated hen breast pH was 5.79, and in marinated hen breast with carrots - 5.5. After cooking, the pH value of meat remained approximately at the same level. Product samples without carrots had higher pH. During 28 days of storage, no significant changes were found in pH of the researched poultry products.

The changes in moisture content of the hen fillet *[musculus pectoralis]* were observed during refrigerated storage and are presented in Fig. 3.

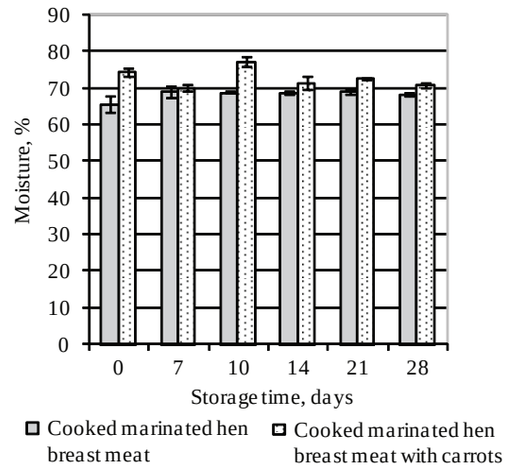



Figure 3. Moisture content in *sous vide* cooked marinated hen breast meat without and with carrots.

Moisture content in *sous vide* cooked marinated hen breast fillet with carrots was higher than in the product without carrots. At the beginning of the storage, moisture content in the sample containing carrots was by 13.5% higher than in the sample without carrots. During the researched storage period, moisture in hen breast meat prepared without carrots was quite consistent – no significant differences were observed. Whereas moisture content in the product containing carrots was periodically increasing and decreasing, although the changes were not significant. It can be explained by the heterogeneity of the sample.

During heating, the different meat proteins denature and cause structural changes in the meat, such as destruction of cell membranes, shrinkage of meat fibers, aggregation and gel formation of myofibrilar and sarcoplasmic proteins, and shrinkage and solubilisation of the connective tissue (Tornberg, 2005). The changes in the hardness during the cooking can be determined by the mechanical rigidity of perimysium in the space endomysium–perimysium, whereas the shortening of endomysium supposes water loss of the muscle (Palka, 1999; Liu et al., 1996). *Sous vide* cooking parameters selected for the current study were selected basing on the previous experiments which provided good product sensory properties - acceptable meat hardness, juiciness, flavour, and colour (Sturmovica et al., 2009).

In the current research, the changes in hardness in the hen fillet *[musculus pectoralis]* were studied during refrigerated storage and are presented in Fig. 4.

Hardness of *sous vide* cooked hen breast meat did not change significantly during the storage period, although tendency of a very slight decrease was observed. The hardness of meat sample containing carrots demonstrated fluctuations up and down, although it was within the range of the standard deviation. A slightly higher hardness was noted in the meat samples cooked together with carrots, although the difference was not significant.

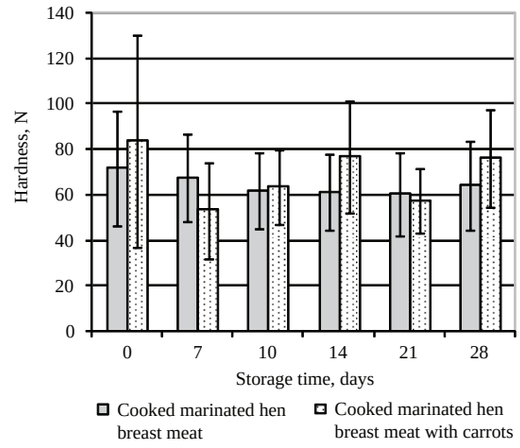



Figure 4. Hardness of the marinated hen breast meat cooked without and with carrots.

Physical-chemical parameters in *sous vide* cooked hen breast meat without carrot additive were better retained during the researched storage time.

**Conclusions**

In both studied products, differences were noted in all studied parameters – water activity, pH, moisture content, weight loss, and hardness. The differences mainly were determined by the properties of the added carrots and sea buckthorn which generally have a higher moisture content and lower pH. The researched parameters were well retained during the refrigerated storage at the 3.0±0.5 °C temperature.

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