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PROSPECTS OF APPLYING VACUUM TECHNOLOGY IN THE MANUFACTURE OF CULINARY POULTRY MEAT PRODUCTS

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Abstract: *This work contains a comparative analysis of organoleptic, physico-chemical and microbiological parameters of food chicken meat products which were made using the vacuum technology and the traditional technology of the Ukrainian producers. The products are made accordingly to a technological scheme, which is developed on the basis of similar traditional technology being normalized by the standards. The evacuation of the product was carried out in industrial conditions, the way of heat treatment of vacuum technology was chosen in accordance with the thickness of the product. The results showed that culinary products made from chicken meat, cooked using the vacuum technology, have better appearance, taste, smell and texture, the output being of 93%, reducing losses by a factor of 4, increasing the shelf life to 5 days. The microbiological research has proven the high reliability of vacuum chicken products and the promise for this technology to be widely applied into industry. The application of vacuum technology opens new prospects of diversifying the range of natural culinary products made from poultry meat, being far superior as regards their nutritional value, organoleptic properties and shelf life, much more convenient in terms of packaging than traditional products.*

Keywords: *technology Sous Vide, the chicken, heat treatment, culinary readiness.*

1. Introduction

In the manufacture of culinary products from meat one of the methods most often used is the surface heating at moderate temperatures (up to 100 ºC, preferably 80-90 ºC).

The most characteristic and important changes, caused by damp heat in the moderat temperature are heat denaturation of soluble proteins, joining and hydrothermal collagen breakdown, the changing of extractives and vitamins, the death of vegetative forms of microorganisms. [1]

The term "Sous Vide" literally from French means "under vacuum" and involves the placement of products in food-grade plastic bag, vacuum them, and then together with the product processing in a water bath at strictly controlled temperatures. The method provides that food is cooked in a sealed environment without oxygen at temperatures below 70 ºC for a long time to achieve culinary readiness. [2, 3]

Nowadays catering is in a state of intensive development, using technological innovations. Heat treatment of raw materials is accompanied by significant changes in the organoleptic, nutritional and biological value, as well as technological losses of mass. In this regard, a priority for the development of food production is to minimize these drawbacks by improving technology. A promising direction of improvement is the handling of raw materials at moderate temperatures prior to

vacuum packing in plastic shrink-wrap, known as Sous Vide technology, which allows you to get food while maintaining weight, nutritional value increase shelf life. The aim of the project was the application of Sous Vide technology for culinary products from poultry meat and its comparison with the traditional technology of similar product.

The composition of meat is approximately 75% water, 20% protein and 5% fat and other substances. The main purpose of heat treatment is denaturation of proteins. The depth of this process depends on its temperature and, to a lesser extent time. The meat proteins are divided into three main groups: myofibrillar (50-55%), sarcoplasmic (30-34%) and the connective tissue proteins (10-15%). The myofibrillar proteins (mostly myosin and actin) and the connective tissue proteins (mostly collagen) contract when heated, while the sarcoplasmic proteins expand when heated. During heating, the muscle fibers shrink transversely and longitudinally, the sarcoplasmic proteins aggregate and gel, and connective tissues shrink and solubilize. Muscle fibers begin to shrink at a temperature of 35-40 ^{o}C and the shrinkage increases almost linearly with increasing temperature up to 80 ^{o}C. Aggregation and gelation of proteins sarcoplasmic begins approximately at a temperature of 40 ^{o}C and ends at 60 ^{o}C. The connective tissue proteins begin to shrink at a temperature of about 60 ^{o}C but a more intensive decrease takes place at 65 ^{o}C.

About 80% of water in muscle tissue is contained in between thick myosin and thin actin fibers. In the temperature range from 40 ^{o}C to 60 ^{o}C muscle fibers shrink in the transverse direction, reinforcing fibers. At temperatures above 60-65 ^{o}C muscle fibers shrink longitudinally and cause substantial water loss increase with increasing temperature. [4]

Nowadays, there is a trend of using the meat and poultry of younger and lean animals. That's why the meat is dry and products are tasteless. To keep natural product made of poultry meat succulent and tender, the temperature of heat treatment shouldn't be exceeded over 60-65 ^{o}C. Traditional methods of cooking poultry are using the temperatures 70-80 ^{o}C depending on the type of a bird and parts of a carcass. The tougher is the meat, the higher are the temperature and the duration of treatment. [5]

Until now culinary readiness of meat products was associated with the temperature of 72 ^{o}C in the center of the product, and the temperatures of an environment higher than 85-90 ^{o}C. The main purpose of this heat treatment is the denaturation of all proteins and destruction of vegetative microorganisms. However, it is now clear that the temperature range of 70-80 ^{o}C greatly affects the number of technological indicators, in particular organoleptic properties, mass loss, and nutritional value. [4, 6]

The advantages of using the Sous Vide technology for the production of meat products following: 1) the product is produced in a sealed environment without oxygen at temperatures below 70 ^{o}C, 2) the absence of oxygen and water increase the amount of nutrients and consequently increase the nutritional value of the product, 3) through a plastic barrier significantly reduces oxidation, retains the properties of the essential polyunsaturated fatty acid lot, reduced the loss of moisture and extractives, whereby the flavors are enhanced, so less spices and salt, 4) the technology of Sous Vide allows us to get useful natural product with completely new flavor-aromatic properties and a new structure in a convenient package for long term storage. [7, 8]

2. Matherials and methods

The experimental part of the work was conducted in the scientific laboratories of the Department of Technology of Meat, Fish and Seafood and Department of Biochemistry, Microbiology and Physiology of nutrition ONAFT. As the object of research was selected chicken, culinary product according to the traditional technology – cooked chicken, evacuation of the product was performed in an industrial environment. In table 1 provides a list of methods for determination used in the experimental studies. [9]

Table 1

Methods of research in the experimental part of scientific work

The name of the indicator	Control methods
Mass fraction of moisture, %	According to Govermment standart 9793
Mass fraction of sodium chloride, %	According to Govermment standart ISO 1841-1:2004
Yield, %	According to [9]
Loss, %	According to [9]
The amount of mesophile and optional-anaerobic microorganisms, colony-generating iteames in 1 g. of the product	According to Govermment standart 10444.15

3. Results and discussion

To achieve the goal of scientific work it was necessary to solve several problems:
1) to justify the production of culinary products from poultry meat using the Sous Vide technology;
2) to make samples of culinary products from poultry meat using the Sous Vide technology and traditional techniques;
3) conduct comparative analysis of organoleptic, physicochemical and microbiological properties of the samples manufactured by two technologies. As the object of research was selected chicken, culinary product according to the traditional technology – cooked chicken. [9]
In Fig. 1 shows a flow diagram for the manufacture of chicken fillet with both technologies.
In case of manufacturing the product using Sous Vide technology, after meat was added into salt and species, it was carried out for the evacuation in food heat-resistant plastic bag and after storage for ripering treatment it was being handled in a water bath at a temperature of 63-65 ^{o}C for 60 minutes.
It should be noted that the modes of thermal processing was determined in accordance with the thickness of the product [6]. The main purpose was to bring the product to the culinary readiness at extremely low temperature for a time that would ensure full denaturation of the protein with the least damage to the nutritional value microbiological stability. Meanwhile, when traditional technology was used, the product was being boiled in water at a temperature 95-98 ^{o}C during 30 minutes until it became culinary ready.
In Fig. 2 shows the context of the product manufactured by both technologies that indicate significant differences of organoleptic characteristics.
Diffenerces between Sous Vide and traditional technology are clearly seen in Fig. 3. Radar chart shows organoleptic evaluation of samples, manufactured according to the traditional technology and the technology of Sous Vide. The sample, which was made using the Sous Vide technology, had more impressive taste and smell, firm and juicy texture, colour and appearance of cut resembled ham product.
Physico-chemical parameters determined the content of moisture, salt and yield and

loss after heat treatment. The results of the comparative characteristics of the indicators are given in table 2, indicate that plastic bag, and low temperature heat treatment prevent loss of water and salt product, which confirms the results of the organoleptic studies, and explains the increase in the yield by 19% and the reduction of losses in 4 times sample, made using the Sous Vide technology.

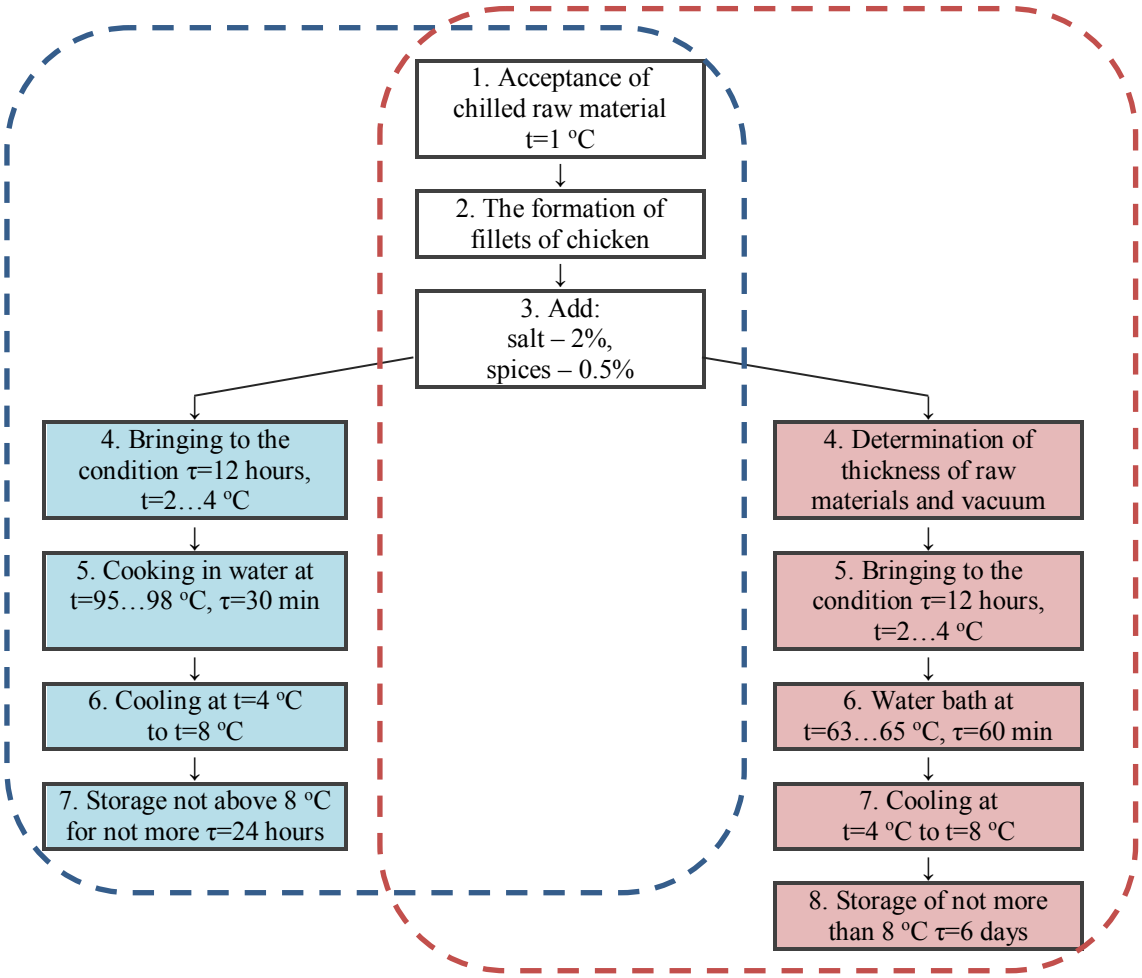

Fig. 1 – The technological scheme of production of chicken in the following technologies: – – – — traditional; – – – — Sous Vide

a **b**

Fig. 2 – View the cut chicken fillets are made: a – according to the traditional technology, b – using the Sous Vide technology

An important step in the research was to prove that the selected modes of heat treatment of the pattern manufactured by using the Sous Vide technology, provide adequate microbiological safety and duration of storage of finished products. In table 3 shows the results of microbiological research of samples manufactured by two technologies, which were stored at a temperature of 2-4 ºC during 6 days. Samples for analyses were taken immediately after manufacture, through the day and on the sixth day of storage. For comparison, similar analyses were conducted for raw meat. Qualitative reaction for anaerobic microorganisms on the environment Kitt-Tarocci on the first day of research gave negative results, as in raw meat and in the samples that were made according to the traditional technology and the Sous Vide technology. Research the amount of mesophile and optional-anaerobic microorganisms, colony-generating iteames in 1 g. of the product indicates that the microbiological safety of Sous Vide technology satisfies the standard requirements for finished products manufactured in Ukraine and extends the shelf life to five days compared to products produced by traditional technology.

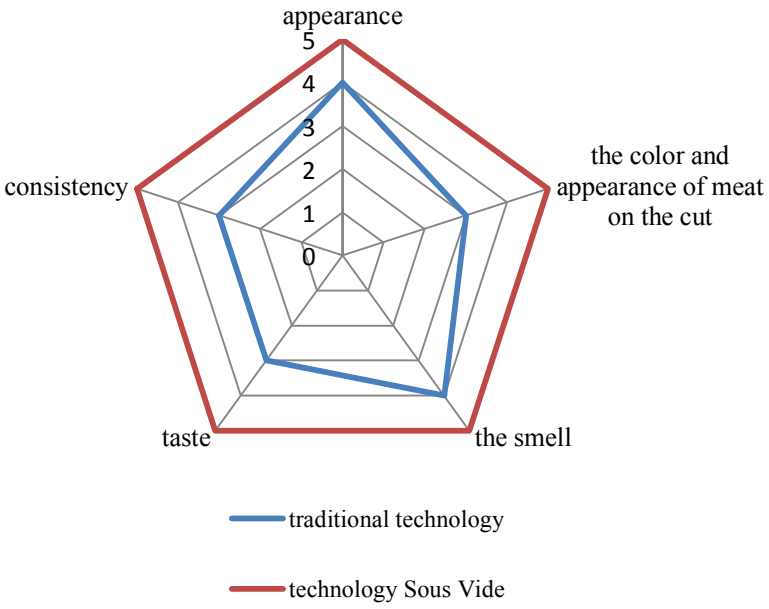

Fig. 3 – The radar chart of organoleptic evaluation on a 5-point scale specimens, manufactured according to the traditional technology and the technology of Sous Vide

The content of moisture and salt, the yield and the product loss after temperature treatment were determined by phisyco-chemical parametres. The results of the comparative characteristics of the indicators are given in table 2, indicate that plastic bag and low temperature heat treatment prevent loss of water and salt product, which confirms the results of the organoleptic studies, and explains the increase in the yield by 19% and the reduction of losses in 4 times sample, made using the Sous Vide technology.

Table 2

Comparative characteristics of physico-chemical properties of the samples made according to the traditional technology and the technology of Sous Vide

The name of the index	The sample made according to the technology		The value of the index according to Govermment standart 4531:2006
	traditional	Sous Vide	
Mass fraction of moisture, %	66.3	74.9	not normalized
Mass fraction of sodium chloride, %	0.6	0.8	1.2
Yield %	74.2	93.4	not normalized
Loss, %	25.7	6.5	not normalized

Table 3

Microbiological properties of the samples, which were stored at t=2-4 ºC

The amount of mesophile and optional-anaerobic microorganisms, colony-generating iteames in 1 g. of the product									
Raw meat			The sample made according to the technology						Standart
			traditional			Sous Vide			
Storage period, days									
0	1	6	0	1	6	0	1	6	
$210*10^3$	$240*10^3$	–	Not allowed	$0.66*10^3$	$1.2*10^3$	Not allowed	$0.61*10^3$	$0.37*10^3$	$< 1*10^3$

4. Conclusion

Sensory characteristics of chicken which was made by the technology Sous Vide greatly surpassed them in comparison with the sample which was made by traditional technology. Namely, the meat was juicier, tender, and solid on the cut, taste was expressed more brightly. The output of chicken fillet which was made by Sous Vide technology increased by 19% in comparison with the sample which was manufactured by the conventional technology, also the product loss decreased in 4 times. Microbiological studies have proved microbiological trustworthiness chicken, made by a technologist Sous Vide on the 6th day of storage compared to the sample made according to traditional technology, the shelf life which is according to Govermment standart 4531:2006 – not more than 1 day.

So, the technology of Sous Vide allows you to get natural (no additives or preservatives) culinary products from poultry meat of high nutritional value, with improved organoleptic properties safe for the consumer during storage for 6 days. This technology is promising for domestic manufacturers of meat products, because gives you the opportunity to expand the range, to provide high yield and extend the shelf life of the finished product.

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