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APPLICATION OF HYDROCOLLOIDS INJECTION IN PROCESSING OF DIFFERENT TYPES OF MEAT RAW MATERIALS BY SOUS VIDE TECHNOLOGY

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Abstract: *The article deals with the peculiarities of application of food composition based on hydro colloids in the processessing of various kinds of meat raw materials by Sous Vide technology. Sous Vide technology allows to maintain high organoleptic characteristics and increase product yield by vacuum packing and heat treatment reduction (Garmash, D., Ramik, O., & Kohan, B., 2018). However, the use of hydrocolloids and their effect on the products processed by the Sous Vude technology is still rational from a technological point of view and a little researched aspect from the scientific point of view (Garmash, D., & Pasichnyi, V., 2017). Given that most hydrocolloid-based food formulations have been developed for traditional heat treatment modes (72-85 ° C), changes in raw materials with reduced treatment temperatures to 55-65 ° C require research (Gai, S., Zhang, Z., Zou, Y., & Liu, D., 2019). According to the design of the experiment, the main raw material was selected meat of broiler chickens (with division into red and white), pork tenderloin and beef. The nutritional composition used in the injection process included the following ingredients - guar gum, sodium citrate, carrageenan purified, xanthan gum, glucose monohydrate (Caporaso, N., & Formisano, D., 2016). After injection and drainage of residual moisture, the samples were portioned - pork was formed into pork chops, the beef was sliced into 100-120 g pieces, and the fillets and thighs of the broiler chickens were portioned as natural semi-finished products. Vacuum portioned samples were cooked with varying temperature variations in the range of 55-65 ° C, after which functional and technological parameters were determined (water holding capacity, total moisture content, ductility and pH of the product). The control group of the samples was treated similarly, but the injection brine only included salt. According to the obtained results, was established the positive effect of the nutritional composition on all studied parameters*

Keywords: *meat, Sous Vide technology, hydrocolloids, poultry, thermal treatment.*

INTRODUCTION

In today's market, storage and organoleptic characteristics of the finished product are becoming increasingly important. On the other hand, at the same time there is an increasing share of products in which a large percentage of meat raw materials are replaced by vegetable products. Thus, the need to create a product with high organoleptic characteristics, shelf life and relatively low cost leads to the search for technologies that would allow to combine the high degree of thermal readiness of the product with low loss of flavoring substances present in meat raw materials is the basis of the characteristic flavor (Kadam, S. U., Tiwari, B. K., & O'Donnell, C. P., 2015).

The use of Sous Vide technology creates the conditions for the production of products with pronounced aromatic characteristics and a texture that is inherent in meat products (so-called "fiber"). These characteristics are achieved by combining the creation of a dilution environment in the middle of the product packaging and reducing the processing temperature. When applying Sous Vide technology, it is important to pay attention to some technological aspects of raw material production and selection. The first aspect is the prevention of

microbiological contamination and the control of the level of anaerobic optional microorganisms. Achieving a tolerable level of microbial growth in a finished product is not always possible due to heat treatment. When using the temperature range at which Sous Vide products are treated (56-64ºC), the effect of heat treatment is often not sufficient to inhibit the microflora in the finished product. From this point of view, a potential solution to this aspect of processing may be to first increase the level of sanitation in the preparation of basic raw materials and, secondly, the use of preservatives or mixtures thereof to inhibit the microflora in the finished product. The second aspect of the processing of products by Sous Vide technology is the reduction of heat treatment while maintaining the acceptable consistency of the product. Thus, based on the above technological aspects, the potential ways of solving the above problems can be called regulation of heat treatment, introduction of preservatives and injection of basic raw materials in order to improve the consistency of the finished product (Naveena, B. M., Khansole, P. S., Shashi Kumar, M., Krishnaiah, N., Kulkarni, V. V., & Deepak, S. J., 2017).

When selecting ingredients for the preparation of brine, it is rational to use citrates and hydrocolloids. Trisodium citrate is added to meat products to increase the ionic strength of the solution. Usually its dosage is from 3 to 5 g / kg of meat product. Citrates, unlike phosphates, do not have a specific effect on the protein, they promote only the swelling of muscle fibers, but not the hydration of the protein (Sun, S., Rasmussen, F. D., Cavender, G. A., & Sullivan, G. A., 2019). Muscle fiber swelling helps retain extra moisture. The fact that citrate is an alkaline organic salt also influences the product and leads to a slight increase in the pH of the latter, and thus contributes to an increase in the water-holding capacity of proteins. The use of phosphates is a traditional practice in the technology of meat products, but the use of this type of ingredients in the technology Sous Vide is complicated by the fact that mostly phosphates are used in restructured products and are introduced in the preparation of minced meat. In the production of whole-muscle products, there is a need for injection and massaging of the basic raw material for better distribution of phosphate brine in the thickness of the product. However, under vacuum, osmotic pressure is achieved, which is the driving force for the spread of the brine throughout the mass of the product. Thus, the processing of meat raw materials by the technology of Sous Vide eliminates the need for massaging the product, which is caused by two factors. The first factor is the less stiff consistency of the finished product due to the specific environment and heat treatment modes of the product. The second factor is the reduction of the average cross-section and the weight of the portion and unit of the product. The relatively low mass of the product is also due to the specificity of the heat treatment - with a sharp decrease in the rate of warming of the thicker product there is a need to ensure the culinary readiness of the product. The positive effects of citric acid and acidic salts of organic acids were revealed in a study by a team of scientists from Korea. Chicken breast moistened with citric acid was treated with sous vide technology and stored refrigerated for 0, 3, 6, 9 and 14 days. The samples were analyzed by dividing the non-saline control group and the three groups maintained at different citric acid concentrations (0.5%, 2.0%, and 5.0%) (Cropotova, J., Mozuraityte, R., Standal, I. B., & Rustad, T., 2019). The yield of the finished product and the moisture content during cooking increased due to citric acid. While the redness of the juice and meat in all groups showed a significant increase during storage, the redness of the groups of samples with the introduction of citric acid decreased compared with the control group. The percentage denaturation of myoglobin groups of samples with acid addition also increased in direct proportion to the percentage of introduction and duration of storage. The total number of aerobic microorganisms, the number of enterobacteria, the reactive substances of volatile basic nitrogen and thiobarbituric acid were generally lower in the samples treated with citric acid than in the untreated ones, indicating a long shelf life of boiled chicken breast or wet soaked chicken breast. The shear force in the 2% and 5% groups was significantly less.

Sous-vide cooking of meats has been a game changer for most restaurants and foodies all around the world, allowing very tender textures of tough cuts and enabling a perfect control of doneness. However, sous-vide cooked meat lacks strong browning on the surface and roasted

flavour notes. Chefs have traditionally use a two stage procedure to overcome this problem, with a more intense cooking method either before or after sous-vide. However, there is a lack of knowledge about the consequences on cooked meat quality parameters, such as cooking loss, water content, colour formation or flavour development. In this study we showed the consequences on these parameters of cooking lamb loins by coupling oven roasting and sous-vide cooking in two possible combinations: sous-vide followed by oven roasting (SV/O) or oven roasting before sous-vide (O/SV) (Petracci, M., Bianchi, M., Mudalal, S., & Cavani, C., 2013). The differences were not so marked, with the exception of a more intense surface browning and lower rate of oxidation to Maillard compounds in SV/O (Baugreet, S., Kerry, J. P., Allen, P., Gallagher, E., & Hamill, R. M., 2018).

The need for the addition of salts of organic acids and phosphate-containing compounds in addition to purely technological ones is also a prerequisite for safety (Roldán, M., Antequera, T., Pérez-Palacios, T., & Ruiz, J., 2014). Microbiological safety and the lethality of low-temperature heat treatment used in the Sous Vide technology is one of the key aspects that may be a hindrance in the widespread use of the technology mentioned above. One of the techniques that prevent the growth of pathogenic and conditionally pathogenic microflora in the finished product is aging in the ambassador and the use of additional preservatives. The Cariotis study shows the effect of pre-salting on the growth of microorganisms in chicken fillets. The heat resistance of a group of five strains of salmonella and five strains of L. monocytogenes was determined in chicken breasts marinated in teriyaki sauce (Nyati, H., 2000). The injected chicken breast, packaged, was completely immersed in a circulating water bath and boiled to a final temperature of 55, 57.5, or 60 ° C for 1 hour, and then held for a predetermined time. Salmonella and surviving L. monocytogenes cells were listed by surface coating on XLD and Palcam agar, respectively. The D values determined by linear regression of salmonella in chicken breast ranged from 47.65 min at 55 ° C to 7.48 min at 60 ° C; values for L. monocytogenes ranged from 54.81 min at 55 ° C to 10.39 min at 60 ° C. Marinating made the pathogen more sensitive to lethal heat. Thus, the effect of the combination of heat treatment and pickling or salting can be quite sufficient even at low temperature processing. However, poultry is a type of raw material that often contains excess moisture and is often counterfeited. From this point of view, the introduction of phosphates and citrates is relevant, as it allows to achieve microbiological stability and increase the mortality of the effects of heat treatment in terms of the growth of MAFAM and other pathogens (Karyotis, D., Skandamis, P. N., & Juneja, V. K., 2017).

EXPOSITION

According to the experimental design, 8 samples were developed based on different types of raw materials. The presented samples are grouped by type of raw material used - 2 samples in each group. Groups of samples based on broiler chicken fillet, broiler chicken meat, pork and beef are presented accordingly. Samples based on pork are formed in the form of culinary semi-finished products - cues. The meat of broiler chickens was processed in the form of natural semi-finished products - fillets in the form of whole pectoral muscles, and the meat of the thigh - together with the bone, as part of the ham. All raw materials were used refrigerated without prior freezing and were not subjected to prior salting. After preliminary purification and washing, all raw materials were portioned and brined at minimum pressure (up to 0.2 Bar). The level of application of brine was 20% by weight of meat raw material before injection. The recipe for brine for samples under number 1 (in all groups by raw material) contained in its composition as the main ingredient of sodium citrate, whereas the recipe for brine. The main purpose of the study was to capture the difference in the studied parameters for samples with different modes of heat treatment. Thus, the heat treatment modes differed respectively for the samples with indexes 1 and 2. After applying the brine and settling the samples for drainage for 1 h, the samples were packed in a polymer film using vacuum and placed in thermal chambers, where the cooking was done in two stages. For specimens with indexes 1, the treatment was carried out at a temperature of 60 ° C for 120 minutes. for chicken and at a similar temperature of 60 ° C for 90 min for other

samples. For samples with indices 2, the cooking was performed at a temperature of 66 ° C for 60 minutes. for broiler chicken fillets, 75 min for thighs and 45 min for other suckers. The difference in treatment durations is due primarily to the different levels of microbial contamination and the level of preservation of the injected brine. After cooking, the samples were unloaded and cooled at room temperature (18-20 ° C) for 2 hours.

Among the studied parameters were selected such as pH value of separated broth and product, moisture and fat content of the finished product, water-holding capacity (WHC) and ductility of the finished product. The product yield and the amount of separated broth were determined by the arbitration method. The pH was measured using a potentiometric laboratory pH meter. Extraction of the extract from the finished product was carried out on the basis of distilled water in an amount of 10 parts relative to the sample weight of the finished product for 30 min. The moisture content was determined after pre-drying the sample (3-5 g) of product at 120-130 ºC to constant weight. The values of OHS were established by the method of pressing the sample (0.28-0.32 g) of the product. The fat content was eliminated by extraction.

Microbiological safety indicators were separately identified. The content of such groups of microorganisms as MAFAM (CFU / g), bacteria of the group of E. coli in 1.0 g, mold, (CFU / g), yeast, (CFU / g) was determined. The content of all groups of microorganisms was determined by standard methods of quality control of the finished products according to the valid permits.

Determination of physico-chemical parameters of finished products

Indicators of finished products are given in table..2. Thus, the values of the basic physicochemical parameters of both groups of samples were at the same level for all types of raw materials except the thighs of broiler chickens. In this sample, there is a noticeable difference in the moisture content values between samples 1 and 2 (63.86 and 49.7, respectively). Such a large difference in the values of this indicator may be due primarily to the presence in the raw material of ingredients that shift the pH of the product and neutralize the action introduced with the brine ingredients (for example, the presence of acidic phosphates neutralize the pH shift caused by alkaline citrates). A distinctive feature is the significant difference in the level of fat separation between the samples based on the thighs of broiler chickens. Such a large difference may be due to the significant variation in the levels of protein binding to fat, which in turn has been influenced by the brine ingredients. The difference in fat content among pork-based samples is also significant, but this may be explained not only by the different effects of the ingredients introduced, but also by the different rheological parameters (based on the fact that the semi-finished product was cooked and low in weight).

Determination of functional and technological indicators of finished products

In terms of changes in functional and technological indicators, all the values obtained are comparable in terms of the level of OHS, and differ significantly in terms of product plasticity. The maximum difference in OV values was recorded in pork-based samples (69% vs. 81%), but this difference for beef (80% vs. 73%) was also significant. Samples based on poultry meat differ significantly in the plasticity of the product. The least plastic is sample 1 based on broiler chicken fillets. It is characteristic that, due to the difference in the heat treatment modes, a large difference in the plasticity of the product for the fillets and thighs of broiler chickens is recorded, which is greater than the difference for the samples in one group. Also, the difference in the values of ductility and WHC can be explained by the different levels of permeability of hydrocolloids, which were introduced together with the brine for different tissues relative to the raw materials used. Therefore, for beef, the permeability of the brine to the fabric was not so pronounced and was low, as demonstrated by the values of plasticity, which was quite low and was at a comparable level.

Thus, it can be concluded that the most sensitive to changes in the heat treatment regimes in this range is an indicator of consistency, and the most characteristic of these changes are for broiler chickens. Depending on the technological tasks set, the choice of heat treatment mode

can be made both in the direction of more rigid and low-temperature heat treatment. Fat content in chicken thigh specimens demonstrates the great effect of changing the thermal modes on the transition of fat from raw material to broth, which is separated when the semi-finished product is heated. In the case of the formulation of a product whose organoleptic characteristics will require the retention of fat in the muscle tissue to achieve the desired level of juiciness, it is rational to process this type of raw material at lower temperatures (with a corresponding increase in the duration of processing of the semi-finished product in the thermal chamber).

Table 1. Indicators of the samples

Name of sample	pH of broth	pH	Moisture content. %	WHC, %	Plasticity, kg/sm^2	Fat content,%
Chicken fillet 1	5,95	5,97	69,36	0,76	336,67	5,45
Chicken fillet 2	6,10	6,19	72,91	0,78	460,00	4,67
Chicken thighs 1	6,40	6,45	63,86	0,68	503,33	20,24
Chicken thighs 2	6,65	6,63	49,47	0,68	433,33	63,38
Pork chop 1	6,15	5,88	65,13	0,69	333,33	11,97
Pork chop 2	6,10	6,10	64,78	0,81	376,67	14,81
Beef thigh (steak) 1	5,90	5,80	51,19	0,80	356,67	42,03
Beef thigh (steak) 2	5,95	5,91	52,27	0,73	366,67	37,19

Determination of microbiological indicators of finished products

The results obtained are shown in Table..2. From the given data we can conclude that a sufficient level of inhibition of pathogenic and conditionally pathogenic microflora is achieved. In all samples tested, the values of the key indicators of the content of the microflora monitored according to the permit documentation were within the acceptable values. In the future, there is a need to investigate the difference in the shelf life of such finished products with the ingredients used in the brine.

Table 2. Microbiological indicators of finished products

	MAFAM, CFU/g	Escherichia coli in 1,0 g	Mold, CFU/g	Yeasts, CFU/g
Beef thigh (steak) 1	$4,0\times10^1$	Not detected	<10	$1,0\times10^1$
Beef thigh (steak) 2	<10	Not detected	<10	$3,0\times10^1$
Pork chop 1	$3,5\times10^1$	Not detected	<10	<10
Pork chop 2	<10	Not detected	<10	<10
Chicken thighs 1	<10	Not detected	<10	<10
Chicken thighs 2	<10	Not detected	<10	<10
Chicken fillet 1	<10	Not detected	<10	<10
Chicken fillet 2	<10	Not detected	<10	<10

CONCLUSIONS

From the above results, it can be concluded that the use of citrate and hydrocolloid-based brines for the injection of products processed by Soud Vide technology is appropriate when used as the main raw material of broiler chickens, beef and pork. The use of these brines has a greater impact on chicken. A high level of organoleptic and functional-technological parameters was achieved with the application of 20% citrate-based brine and heat treatment using both methods. The heat treatment modes must be adjusted according to the specified technological task. Changing the heat treatment modes has a major impact on the chicken, in particular its consistency of the finished product and the proportion of separated fat. Further studies require a

difference in the effect of phosphate and citrate mixtures on different semi-finished products from broiler chickens.

The microbiological safety of the finished product was sufficient for all the samples tested, however, the difference in the effect of mixtures of hydrocolloids and phosphates or citrates on different types of semi-finished products based on broiler chickens remains unclear.

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