SENSORY ANALYSIS OF MARINADES AND READY-MADE CULINARY MEAT PRODUCTS ENRICHED WITH OIL MACERATES AND WATER-ETHANOL HERBAL EXTRACTS

Albena **Parzhanova**[1], Ivelina**Vasileva**[2], Anton **Slavov**[2], Dimitar **Dimitrov**[3*], Snezhana **Ivanova**[4]

[1]Agricultural Academy, Department of Food Technologies, Institute of Food Preservation and Quality, 154 Vasil Aprilov Blvd, 4002, Plovdiv, Bulgaria
[2]Department of Organic Chemistry and Inorganic Chemistry, University of Food Technologies,26Maritza Blvd.,4002, Plovdiv, Bulgaria
[3]Agricultural Academy, Department of Selection, Enology and Chemistry, Institute of Viticulture and Enology, 1 Kala Tepe str.,5800, Pleven, Bulgaria
[4]Department of Catering and Nutrition, University of Food Technologies, 26 Maritza Blvd, 4002, Plovdiv, Bulgaria
*E-mail: dimitar_robertov@abv.bg

Abstract
Sensory analysis of marinades applicable to meat products enriched with oil and various concentrations of water-ethanol herbal extracts was performed. The recipe composition of the marinade with 30% water-ethanol extract of hawthorn flowers for veal portion semi-finished product and of marinades with 50% water-ethanol and oil extracts of: thyme (Thymus callieri Borbás ex Velen), St. John's wort (Hypericum perforatum L), ligulate thistle (Cirsium ligulare Boiss), hawthorn-berries (Crataegus monogyna Jacq.), hawthorn-flowers (Crataegus monogynaJacq.)andjuniper-berries(JuniperuscommunisL) was proposed. Conventional two-stage extraction was used to obtain aqueous, water-ethanol (30%, 50%) and extracts type "decoct" of medicinal plants identified for the region of the Western Rhodopes, Bulgaria. The oil extracts of the herbs were prepared from fresh or dried plant material with sunflower oil extractant. The sensory analysis of marinades and finished meat products was performed using a hedonistic modified five-point scale and statistical data processing. According to the evaluators the best taste and aromatic qualities had the marinade with added oil extracts and 50% ethanol extract of juniper berries and meat marinated with it. High tasting ratings were given to marinades with extracts from the berries of the hawthorn plant, followed by those with thyme. This trend was maintained in marinated and roasted veal, regardless of its size. Marinating solutions improved the juiciness and tenderness of the meat. Small portion and portion meat was suitable to be marinated by soaking, and for large portion meat - by injecting of the marinade.

Keywords: Marinade, portion veal, sensory analysis, water-oil emulsion, oil extract, water-ethanol extract, recipe composition.

Received: 30.01.2022 Reviewed: 07.02.2022 Accepted: 07.02.2022

1. INTRODUCTION

Meat flavoring is the one of the main technologies used in the production of processed meat, as it improves the shelf life, taste, juiciness and tenderness of meat products (Inguglia et al., 2018). Marinating is a process of introducing solutions in meat tissue in order to improve the quality of marinated meat, its appearance and shelf life. Marinating solutions improve the juiciness and tenderness and increase the yield of the finished product by increasing the amount of added water (Sheard et al., 2004; Vlahova-Vangelova et al., 2013).
The use of marinade solutions, due to the retention of added water, improves the juiciness, tenderness, but also increases the weight of the finished product. The concentrations of individual ingredients should be sufficient to improve the relevant indicators

without adversely affecting the taste and color (Sheard et al., 2004; Balev et al., 2011). Many research teams work on the marinating process and its impact on the quality and organoleptic characteristics of marinated products.

Sensory analysis of raw samples of marinated sheep meat, roasted after storage in the marinade for 24 hours under refrigerated conditions was performed (Vlahova-Vangelova et al., 2013). Alkaline and acid marinades were used and the comparisons between them was made. It has been found that the applying of alkaline and acid marinades was possible to improve the organoleptic characteristics (aroma, taste, tenderness) of sheep meat. The results of the sensory analysis were confirmed by light microscopy of the marinated meat samples. Significant swelling as a result of an increase in the amount of water involved in muscle tissue has been found in alkaline marinated sheep meat. The best embrittlement was obtained by alkaline marinating of the meat (for 24h and 48h), followed by acid marinating at the same time. The most attractive was the color of raw sheep's meat marinated with an alkaline solution, and polyphosphates were added to the marinade. And in acid solution, sodium lactate was added. Marinating in water-oil emulsion proved to be the least suitable for processing of sheep meat (Vlahova-Vangelova, 2014a; 2014b).

Maxwell et al. (2018)performed sensory analysis of chicken fillets marinated in vacuum with a marinade containing sodium chloride and sodium tripolyphosphate, determining the effects of marinating on sensory characteristics and instrumental measurements of ventral (skin) shear force and the dorsal (bone-side) portions of unmarinated and marinated meat.The visual, textural and taste qualities of the portioned chicken breasts were evaluated by developed scale from 0 to 15 points, together with the shear strength of Warner-Bratzler. No significant effects of interaction between frozen chicken meat and marinade were observed for sensory characteristics. Greater elasticity, density, hardness, fibrousness and chewability were observed in samples of chicken breasts, which were characterized by higher hardness of "wooden breast" ($p < 0.001$).The marinating process reduces cohesion, hardness and chewing ($p < 0.05$) and increases juiciness ($p = 0.002$). The effects of marinating on chicken breasts and their characteristics of sensory texture were found to be more obvious in the ventral parts of the breast. Flavor indicators (salty and broth) increase ($p < 0.001$) with the marinating process. In non-marinated samples, the shear strength was similar between normal and frozen chicken breasts (Maxwell et al., 2018).

Sensory evaluation of meat, connective tissue, fat content, and heat loss can directly affect sensory textural characteristics such as tenderness and juiciness (Purslow, 2005).

Standard marinades without the use of herbal extracts were used, and the effect of NaCl, KCl and $MgSO_4$ on beef was studied, where salts were used in standard marinades at a concentration of 5.5%. Subsequently, a sensory assessment was performed using a hedonistic 9-point scale and eight expert tasters. High correlations have not been found (Perisic et al., 2013).

Sensory characteristics of aged broiler fillets marinated in 6% NaCl solution containing 2% sodium tripolyphosphate (2P), 2% citric acid (2C), 2% acetic acid (2A), 1% citric acid plus 1% phosphate solution (1C) or 1% acetic acid solution plus 1% phosphate (1A) were tested.6% NaCl solution without additives was used for control. The samples after marinating were thermally treated, baked in an oven at

177ºC until reached culinary readiness with a measured of 75 °C internal temperature. The tasting committee was composed of 9 experts. The main indicators of quality were evaluated by 15-point scale (Lyon et al., 2005).

Numerous publications have been found in the available literature on the influence of marinade solutions on the morphological and organoleptic characteristics of pork, poultry and beef. Therefore, in order to present this study, we set out the aim to determine the influence of the type of marinade on the sensory and textural characteristics of veal (VPM) with included oil extracts (macerate type) and 50% water-ethanol extracts (decoct type) in the marinade solution.

2. MATERIALS AND METHODS

Materials

•Used herbs from the region of Dospat, western Rhodopes: thyme (*Thymus callieri* Borbás ex Velen), St. John's wort (*Hypericum perforatum* L), ligulate thistle (*Cirsium ligulare* Boiss), hawthorn-berries (*Crataegus monogyna* Jacq.), hawthorn-flowers (*Crataegus monogyna*Jacq.)andjuniper-berries(*Juniperuscommunis*L).

• 95% ethanol was used to prepare the extracts, and 30, 50 and 70% ethanol was obtained from it by dilution to obtain liquid extracts with polar volatile extractant (ethanol with four concentrations - 30, 50, 70 and 95%);

• Vegetable oil (refined sunflower oil-oleic type), produced by “Papas Oil” Ltd, Veliki Preslav, Bulgaria.

• Water (the water must meet the requirements for drinking water - Ordinance № 9 of 16.03.2001 on the quality of water intended for drinking and household needs);

• Sugar (white, crystal) – “Sweet Life” Ltd, Serbia - corresponds to Bulgarian National Standard 1-77;

• Salt (table, iodized) – “Lubex” Ltd, Bulgaria, NaCl content - 99.5%; KI - 28 - 55 mg/kg;

• Soy lecithin without preservatives (E322), purchased from “Biorest” Ltd, Sofia, Bulgaria.

• Mustard (traditional) - "Deroni" Ltd, Stara Zagora, Bulgaria;

• Raw materials for veal semi-finished products: For the purposes of the study, a chilled contrafile obtained from a 7-month-old calf (raised on a farm of "Mexi-mes" Ltd, in the region of Dospat, Bulgaria) was used. The meat was stored in refrigerated conditions.

A recipe composition and technology of water-oil emulsions for marinating have been developed. The emulsions were enriched with functional components from various plant sources, containing biologically active substances (BAS), which were an integral part of healthy foods. Based on preliminary research on water-oil emulsions for marinating, as a result of selection, three assortments of marinade solutions have been developed (without emulsifier, with mustard and with soy lecithin). The previously studied extracts of hawthorn flowers (*Crataegus monogyna* Jacq.) were included. (Table 1).

All three assortments were prepared using oil extracts of hawthorn flowers (*Crataegus monogyna* Jacq.) (20%) and refined high-oleic sunflower oil for the oil phase (OP). 30% water-ethanol extract (40%) was used for the aqueous phase (AP). The additional used components were salt, sugar, emulsifier (mustard or soy lecithin).

The studied new assortments - marinades (pure, with mustard and lecithin) were evaluated by the intensity of the main taste indicators - salty, sour, sweet, bitter, alcohol and fat.

Table 1. Model recipe composition of marinades with 30% water-ethanol extract of hawthorn flowers (*Crataegus monogyna* Jacq.) for veal portioned semi-finished product

RAW MATERIAL, %	ASSORTMENTS		
	Marinade, **clean** (without emulsifier)	Marinade with **mustard**	Marinade with lecithin
	MC	**MM**	**ML**
30% water-ethanol extract of hawthorn (flowers)	40.0	40.0	40.0
Oil extract	20.0	20.0	20.0
Refined high oleic sunflower oil	36.5	34.5	34.5
Salt	1.5	1.5	1.5
Sugar, crystalline	2.0	2.0	2.0
Mustard, delicacy	–	2.0	–
Lecithin, soy	–	–	2.0

The following methods have been used to prepare the extracts used:

• *Conventional two-stage extraction to obtain water, water-alcohol (30%, 50%) and alcoholic extracts (decoct type)*

Hydromodule 1:20 for dry and 1:30 for frozen plant mass of thyme (*Thymus callieri* Borbás ex Velen), St. John's wort (*Hypericum perforatum* L), ligulate thistle (*Cirsium ligulare* Boiss), hawthorn-berries (*Crataegus monogyna* Jacq.), hawthorn-flowers (*Crataegus monogyna*Jacq.) and juniper-berries (*Juniperus communis* L) saturated up to 1.5 cm was used for obtaining extracts (decoct type). In this case 15 g of the raw material were weighed and transfered to flask containing 300 cm^3 of the extractant - water, 30%, 50%, 70% and 95% ethanol (V1, cm^3), heated to 60 - 65 °C. The temperature was maintained for 1 hour, after which the mixture was allowed to stand overnight at room temperature. After that the mixture was filtered through a nylon cloth. The residue was returned to the flask and filled with 200 cm^3 of the corresponding extractant (V2, cm^3). The second extraction lasted 1 hour at the same temperature (60 - 65 °C). Then the mixture was filtered. The extract (water, hydroethanol or ethanol extract) was retained for analysis and the residue after the last filtration was dried in an oven at 30 ºC.

• *Preparation of oil extracts*

In Bulgaria the oil extracts were obtained only from fresh or dried plant material with sunflower or castor oil extractant. Abroad, the extract was prepared according to the pharmacopoeia and was produced mainly with olive oil.

According to the technologies developed at the University of Food Technologies - Plovdiv (Georgiev and Stoyanova, 2006), fresh raw materials were extracted for 24 ÷ 48 hours at 80 °C with continuous stirring. If the raw material is dry, it is necessary to be pre-wet to 70% humidity (Georgiev, 1998, 2007).To obtain oil extracts, pre-grounded and wetted dry plant raw materials from the studied plant species were used, which were extracted by the above-mentioned way (Stoyanova, 1986; 2007).

•*Preparation of marinade*

Water-soluble ingredients (salt, sugar and mustard) were pre-weighed. Then they were added to 50% water-ethanol part of the marinade composition. In order to mix, the ingredients were pre-mixed and homogenized for 1 minute. The oil phase (vegetable oil or oil extract) was added to the mixture thus prepared. Homogenization continued for another 2 minutes. A water-oil emulsion for marinating with 50% oil phase and mustard (marinade) was obtained. One part of it was separated for sensory analysis, and the other was used for marinated of a pre-prepared veal semi-finished product - veal contra fillet. Based on above mentioned we developed a technological scheme of marinating and processing of heat-treated culinary product (Scheme 1).

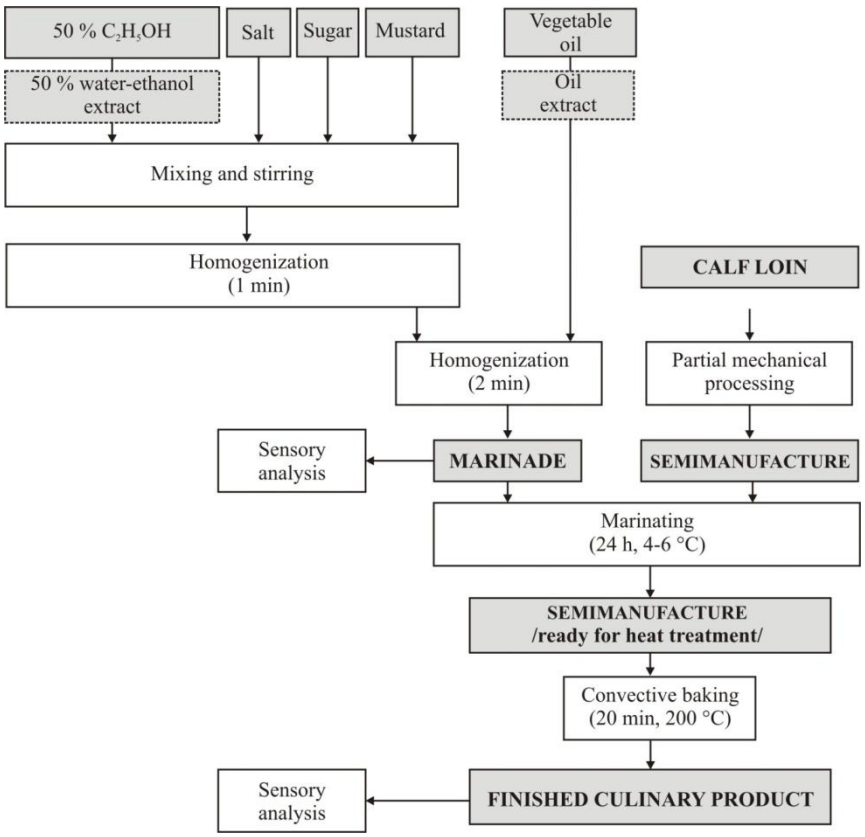
• *Preparation of meat samples*

For the purpose of the research, partial mechanical processing of the meat was performed. Meat samples (semi-finished products) were obtained from veal, cut into three sizes:

Portion (PVSP1) veal semi-finished product - approximate dimensions 10 x 7 x 3 cm and weight 270 ÷ 300 g;

Portion (PVSP2) veal semi-finished product - approximate dimensions 7 x 7 x 1 cm and weight 100 ÷ 120 g;

Small portion (SVSP) veal semi-finished product - approximate dimensions 3 x 3 x 1 cm and weight 20 ÷ 30 g.



Scheme 1. Technological scheme for obtaining marinade and marinated veal semi-finished product (VSP) enriched with biologically active substances

• *Marinating*

The obtained veal semi-finished products were placed in individual and well-marked packages with lids. Poured over the marinade obtained immediately after its preparation and stored under refrigerated conditions (4 - 6 °C) for 24 hours.

•*Convective baking and obtaining a ready-made culinary product*

After 24 hours, the pieces of meat were removed from the marinade and baked in a convectional oven at 180 °C for 1 hour and 20 minutes to obtain a finished culinary product. It was subjected to analyzes immediately after reaching culinary readiness.

• *Sensory analysis*

The sensory analysis of the new assortments was performed using a hedonistic modified five-point scale, where 5 corresponded to the highest and 1 to the lowest score for the given indicator (ISO-5492; ISO 13301-1:2000; Herbert and Sidel, 1998; Carpenter et al., 2000). According to the performed sensory analysis statistical data processing was performed.

• *Statistical processing*

Data were presented by their mean values and standard deviations (± SD), calculated on the basis of triplicate. Statistical analysis of the data was performed by one-way analysis of variance (ANOVA) at a significance level of 0.05. In cases of significant differences, multiple comparisons (post hoc analysis) were made by the LSD method. Microsoft Excel was used for statistical processing of the obtained experimental data and the graphic layout of the obtained results.

3. RESULTS AND DISCUSSION

The obtained average evaluations of the taste indicators of the marinade and marinated and heat-treated veal semi-finished product (VSP), according to the evaluators, are presented graphically in Figure 1.

In water-oil emulsions for marinating, the salty taste was felt moderately strongly to strongly in the finished marinade, while in marinated meat samples, the salty taste weakened to a perceptible. A similar trend was observed in the indicator of sweetness. For this reason, the amounts of salt (1.5%) and sugar (2.0%) in the model recipe for all three items were retained.

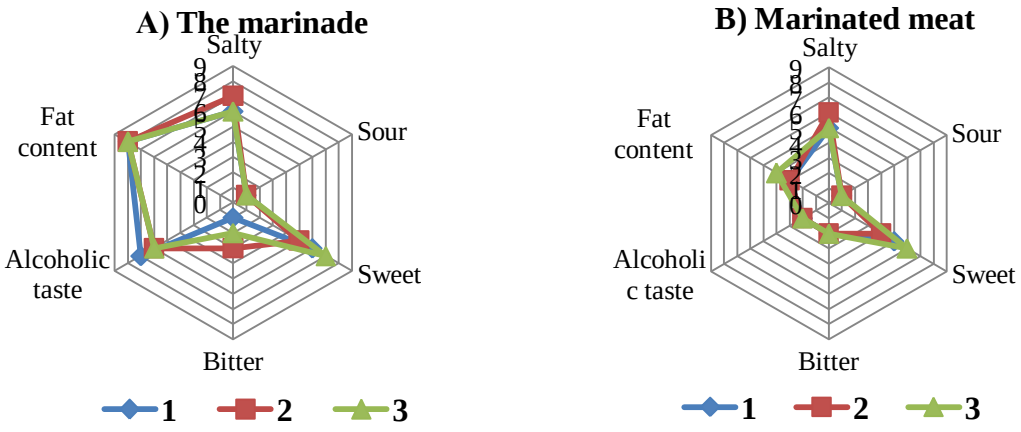


Figure 1. Sensory profile of marinade (A) and marinated veal semi-finished product (B)

The sour taste was absent, both in the marinade and in the finished culinary product, because the recipe was not contain raw materials with a sour taste (wine, vinegar, lemon juice, tomato juice, ketchup, etc.). Slightly perceptible bitterness was felt in the mustard marinade, which was typical of the ingredients used, but this made the taste even more interesting and acceptable.

The feeling of oiliness (fat content) was very strong in all three combinations of marinades, as the oil feeling sharply decreased to slightly and moderately noticeable after marinating and roasting of SVSP. Therefore, the amount of oil fraction in all three combinations of water-in-oil marinade emulsions could be increased up to 50%.

The taste of alcohol was strong in marinades without emulsifier, and it was less noticeable in marinades with added mustard and soy lecithin. During marinating and especially during the heat treatment of the meat semi-finished product, the ethanol evaporated and was absent or barely perceptible in the three assortments of small portion veal semi-finished products (SVSP), pre-marinated with water-oil emulsions for marinating, with 30% water-ethanol hawthorn flowers extracts. For this reason, and in order to soften the meat, the concentration of ethanol in the extracts could up to 50%.

The introduction of 2.0% emulsifier (mustard or soy lecithin) to the recipe at the expense of the amount of added vegetable oil, improved both the emulsifying properties of the marinade and its taste, suppressing sharp taste. The marinade with mustard and marinated and baked small portion of veal semi-finished product (SVSP) was slightly better perceived than the marinade with soy lecithin and marinated and baked SVSP, but the difference was not drastic and both emulsifiers could successfully used in quantities of 2.0%.

The obtained results allowed us to proposed in Table 2 a prescription composition that will find application in culinary technology in the next research related to the selection of a suitable herbal extract.

In the course of the study it was concluded that the recipe for marinade type water-oil emulsions, including herbal extracts (oil and water-alcohol), included in the aqueous phase: water-alcohol extract with 50% ethanol content, salt, sugar and mustard, and in the oil phase - oil extract and high oleic refined sunflower oil.

Table 2. Developed recipe composition of the marinade for veal portion semi-finished product with 50% water-alcohol and oil extracts

RAW MATERIAL, %	ASSORTMENTS	
	Control	Marinade with **mustard**
	K	**MM**
50 % C_2H_5OH	44.5	–
50 % water-ethanol extract	–	44.5
Oil extract	–	50.0
Refined high oleic sunflower oil	50.0	–
Salt	1.5	1.5
Sugar, crystalline	2.0	2.0
Mustard, delicacy	2.0	2.0

Based on all above studies we chosen the most appropriate technological conditions for quality of the proposed technology and 7 samples of extracts were prepared - a control sample and six variants, which differed in the type of plant material (thyme, St. John's wort, ligulate thistle, hawthorn flowers, hawthorn berries and juniper berries) with which the oil and 50% water-ethanol extracts were prepared.

The marinades prepared according to the technological scheme were water-oil emulsions for marinating with 50% oil phase. The main organoleptic indicators - appearance, consistency, color, smell and aroma, taste and aftertaste /residual taste/ were evaluated. These properties were crucial for the overall perception and application of marinades with added plant extracts.

The results obtained from the sensory analysis of the marinade samples are presented graphically in Figure 3, and the overall sensory evaluation is presented in Table 3.

The results showed that the use of herbal extracts improved the quality of the marinade. As the tasters gave the highest marks for marinades with extracts of juniper berries, followed by those with thyme and hawthorn (flowers and berries). Low values close to those of the control were obtained for marinades with St. John's wort and ligulate thistle.

Table 3. Data for the total sensory evaluation of the marinades

Sample	Control K	Variant 1	Variant 2	Variant 3	Variant 4	Variant 5	Variant 6
	Control	Thyme	St. John's wort	Ligulate thistle	Hawthorn (flowers)	Hawthorn (berries)	Juniper (berries)
Total sensory evaluation	19.8	28.4	20.4	21.6	29.8	27.6	32.6

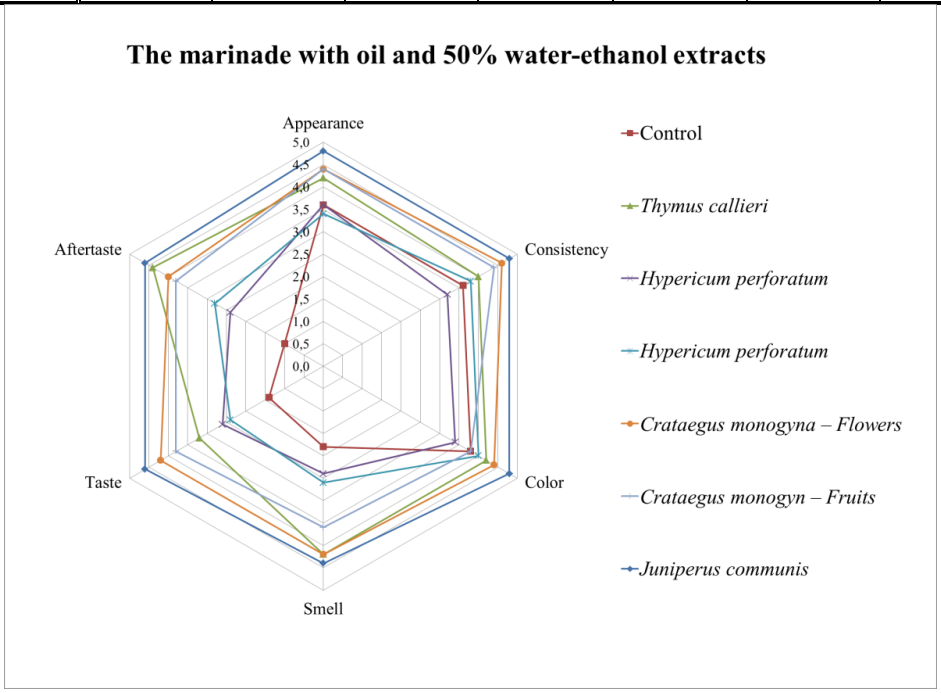


Figure 2. Results of the tasting analysis of marinades with added oil and water-ethanol (50%) extracts

The same trend was maintained in the final marinated and baked veal semi-finished product.

The addition of new raw materials (oil and 50% ethanol extracts) in established recipe compositions led to a change in the sensory and morphological qualities of the final culinary product. Therefore, from each assortment, namely marinated and roasted veal - PVSP1 and PVSP2, immediately after roasting, 10 organoleptic indicators were evaluated, in which changes would occur due to the use of herbal extracts. The ten-member tasting commission filled the tasting cards for each assortment, using a 5-point grading system.

Table 4 presents and compares the estimates for the two types of heat-treated, pre-marinated, veal semi-finished products.

Table 4. Data from sensory analysis of marinated and heat-treated PVSP1 and PVSP2

Indicators	Control	Variant 1	Variant 2	Variant 3	Variant 4	Variant 5	Variant 6	p-value
	Control	Thyme	St. John's wort	Ligulate thistle	Hawthorn (flowers)	Hawthorn (berries)	Juniper (berries)	
PVSP1								
Appearance	3.3 ± 1^{b} *	3.9 ± 0.9^{ab}***	3.3 ± 1.2^{b}	3.1 ± 1.1^{b}	3.6 ± 0.9^{ab}	4.4 ± 0.5^{a}	4.3 ± 1.1^{a}	**0.031****
Bark color	3.8±0.8	3.9±1.1	3.3±1.1	3.6±1.1	3.8±0.7	4±1	4.1±1.1	0.698
Color of the middle	3.4±0.9	3.9±0.9	3.3±1	3.4±1	3.3±0.9	4.1±1.1	4±1	0.380
Smell	3.1 ± 0.8^{c}	3.2 ± 1.4^{bc}	2.9 ± 0.8^{c}	3.2 ± 1.1^{bc}	3.6 ± 0.9^{abc}	4.1 ± 0.8^{ab}	4.3 ± 0.7^{a}	**0.014**
Aroma	3.3 ± 1.2^{bc}	3.3 ± 1.3^{bc}	2.9 ± 0.8^{c}	3.1 ± 1.1^{c}	3.8 ± 1^{abc}	4.2 ± 0.4^{ab}	4.3 ± 0.5^{a}	**0.012**
Taste	3.3 ± 1^{c}	3.6 ± 1.1^{bc}	2.8 ± 1.1^{c}	3.1 ± 1.2^{c}	3.6 ± 0.9^{bc}	4.2 ± 0.4^{ab}	4.6 ± 0.5^{a}	**0.002**
Aftertaste	3.1 ± 1.3^{c}	3.3 ± 1^{bc}	3 ± 0.9^{c}	3 ± 0.9^{c}	3.1 ± 0.9^{c}	4 ± 0.5^{ab}	4.2 ± 1^{a}	**0.027**
Tenderness	3.1 ± 0.8^{c}	3.6 ± 0.7^{abc}	2.9 ± 1.1^{c}	2.9 ± 0.9^{c}	3.3 ± 1^{bc}	4 ± 0.5^{ab}	4.2 ± 0.7^{a}	**0.004**
Chewability	2.9 ± 0.9^{cd}	3.6 ± 0.9^{abc}	2.6 ± 1^{d}	2.8 ± 0.8^{cd}	3.4 ± 0.9^{bc}	4 ± 0.5^{ab}	4.3 ± 0.7^{a}	**0.000**
Juiciness	2.9 ± 1.1^{c}	3.4 ± 1.1^{abc}	2.8 ± 1.1^{c}	3 ± 0.9^{bc}	3.6 ± 1^{abc}	4 ± 0.5^{a}	3.9 ± 0.8^{ab}	**0.048**
PVSP2								
Appearance	3.7 ± 0.9^{b} *	3.8 ± 0.8^{b} ***	3.7 ± 0.7^{b}	3.7 ± 0.9^{b}	4 ± 1^{ab}	4.6 ± 0.7^{a}	4.7 ± 0.5^{a}	**0.024****
Bark color	3.7 ± 0.7^{c}	3.6 ± 0.7^{c}	3.4 ± 0.5^{c}	3.6 ± 0.7^{c}	3.9 ± 0.9^{bc}	4.3 ± 0.7^{ab}	4.6 ± 0.5^{a}	**0.007**
Color of the middle	3.7 ± 0.7^{c}	3.6 ± 0.7^{c}	3.4 ± 0.5^{c}	3.6 ± 0.7^{c}	3.9 ± 0.9^{bc}	4.3 ± 0.7^{ab}	4.6 ± 0.5^{a}	**0.007**
Smell	3.6 ± 0.9^{bc}	4.1 ± 0.6^{ab}	3.3 ± 0.7^{c}	3.7 ± 0.9^{bc}	3.7 ± 1^{bc}	3.9 ± 1.1^{bc}	4.8 ± 0.4^{a}	**0.012**
Aroma	3.6 ± 0.9^{bc}	4.1 ± 0.6^{b}	3.3 ± 0.7^{c}	3.7 ± 0.9^{bc}	3.7 ± 1^{bc}	4 ± 1^{bc}	4.9 ± 0.3^{a}	**0.004**
Taste	3.4 ± 0.7^{bc}	4 ± 0.5^{b}	3.2 ± 0.7^{c}	3.4 ± 0.9^{bc}	3.6 ± 0.9^{bc}	3.9 ± 1.2^{bc}	4.8 ± 0.4^{a}	**0.002**
Aftertaste	3.3 ± 0.7^{b}	3.6 ± 0.7^{b}	3.1 ± 0.8^{b}	3.3 ± 1.1^{b}	3.6 ± 0.9^{b}	3.9 ± 1.2^{b}	4.8 ± 0.4^{a}	**0.004**
Tenderness	3.6±0.7	3.7±1	3.4±0.7	3.7±0.9	3.9±1.3	3.9±1.1	4.8±0.4	0.06
Chewability	3.6±0.7	3.7±1	3.4±0.7	3.7±0.9	3.9±1.3	3.9±1.1	4.8±0.4	0.06
Juiciness	3.3 ± 0.7^{b}	3.6 ± 0.9^{b}	3.2 ± 0.8^{b}	3.4 ± 1^{b}	3.9 ± 1.3^{b}	3.9 ± 1.1^{b}	4.8 ± 0.4^{a}	**0.014**

* Values are mean ± standard deviation

** The bold values of p-value are less than 0.05, which shows that there is a statistically significant difference between the average scores of the corresponding order.

*** In each of the lines with bold p-value, the averages with at least one identical letter do not differ statistically according to the LSD test at a significance level of 0.05.

The last column gave the p-values obtained from the application of ANOVA. When p <0.05, the scores on the respective indicator were statistically different, and conversely, if p> 0.05, the scores on the respective indicator was not differ statistically significantly.

In order to establish where the differences in the assessments of these indicators were, multiple comparisons (post hoc analysis) were performed by the LSD method, the results of which were presented in the corresponding rows of the indicators in table. 4. Averages with at least one identical letter was not differed statistically according to the LSD test at a significance level of 0.05.

For easier interpretation of the results and to be more informative they were grouped:

- the first group provided information on the indicators - appearance, bark color and color of the middle;
- the second group - smell, aroma, taste and aftertaste/residual taste (oral cavity);
- the third group - tenderness, chewiness and juiciness of the meat.

The indicators by groups, their average values by groups and average sensory evaluation are presented and compared in Table 5.

Table 5. Average sensory evaluation of marinated and heat-treated PVSP1 and PVSP2

№	Sensory indicators	Control K	Variant 1	Variant 2	Variant 3	Variant 4	Variant 5	Variant 6
		Control	Thyme	St. John's wort	Ligulate thistle	Hawthorn (flowers)	Hawthorn (berries)	Juniper (berries)
PVSP1								
1	Appearance	3.5±0.3	3.9±0.0	3.3±0.0	3.4±0.3	3.6±0.3	4.2±0.2	4.1±0.2
2	Bark color							
3	Color of the middle							
4	Smell	3.2±0.1	3.5±0.1	3.1±0.1	2.9±0.1	4.1±0.1	4.1±0.1	4.4±0.2
5	Aroma							
6	Taste							
7	Aftertaste							
8	Tenderness	3.9±0.1	4.0±0.1	4.1±0.4	4.2±0.1	3.9±0.1	4.3±0.1	4.5±0.1
9	Chewability							
10	Juiciness							
Average sensory evaluation		3.5±0.1	**3.8±0.3**	3.4±0.6	3.6±0.6	3.7±0.2	**4.2±0.1**	**4.3±0.2**
PVSP2								
1	Appearance	3.7±0.0	3.6±0.1	3.5±0.1	3.6±0.1	3.9±0.1	4.4±0.1	4.6±0.1
2	Bark color							
3	Color of the middle							
4	Smell	3.5±0.1	3.9±0.3	3.3±0.1	3.5±0.2	3.6±0.1	3.9±0.1	4.8±0.1
5	Aroma							
6	Taste							
7	Aftertaste							
8	Tenderness	3.5±0.1	3.7±0.2	3.5±0.2	3.7±0.2	4.0±0.2	4.0±0.1	4.8±0.0
9	Chewability							
10	Juiciness							
Average sensory evaluation		3.6±0.1	3.7±0.2	3.5±0.2	3.6±0.1	3.8±0.2	4.1±0.3	4.7±0.1

From the presented data it was evident that the three marinades stand out clearly. This trend was maintained in the final culinary products that were marinated with them.

Consumers placed the highest rating on marinade and marinated meat (**PVSP1** and **PVSP2**) with extracts obtained from juniper berries. After them, the meat marinated with hawthorn berries extracts was highly valued, and the third place was given to marinated meat with thyme extracts. According to evaluators, the aroma and taste of juniper and hawthorn made the product more interesting and mysterious, while that of thyme was liked, but it was more traditional and familiar.

The meat with smaller size had better taste, and there was no change in the taste and volume of the large ones. The reason for this was that the marinade fails to penetrate in the meat.

On the other hand, the meat of large-sized veal semi-finished product was juicier and tender, regardless of the type of marinade. Therefore, it was recommended for these assortments to be marinated by injecting the marinade in the entire volume of the meat, and not by soaking (this method was suitable for portion and small portion meat.

The marinades were not significantly changed the appearance, bark color and the color in the middle, although different marinades had different colors due to the different colors of the extracts used. The changes in the color of the semi-finished product were the result of dextrinization, which promoted the formation of yellow to brown color, as well as the partial caramelization of carbohydrates and melanin formation reactions on the surface of the meat. However, higher values of these indicators again received the meat that was marinated with marinades with juniper, hawthorn and thyme.

4. CONCLUSIONS

As a result of the conducted sensory analysis and statistical processing of the data after the tasting of marinades and ready-made culinary meat products enriched with oil macerates and water-ethanol herbal extracts, the following conclusions can be made:

• According to the evaluators the best taste and aromatic qualities had the marinade with added oil extracts and 50% ethanol extract of juniper berries and meat marinated with it. High tasting ratings were given to marinades with extracts from the berries of the hawthorn plant, followed by those with thyme. This trend was maintained in marinated and roasted veal, regardless of its size.

• Marinating solutions improved the juiciness and tenderness of the meat. Small portions and portion meat was suitable to be marinated by soaking, and for large portion meat - by injecting of the marinade.

5. REFERENCES

[1] Vlahova-Vangelova, D., Abzhanova, Sh., Dragoev, St. Influence of the type of marinade on the morphological and organoleptic characteristics of sheep's meat, *Scientific papers of UFT-Plovdiv from the conference "Food Science, Technic and Technology - 2013", LX*, 2013, p: 237-241.

[2] Georgiev, E. Technology of natural and synthetic aromatic products, Plovdiv, 1998; 2007. pp: 17.

[3] Georgiev, E., Balinova-Tsvetkova, A., Hristova, P. Influence of some technological factors on the yield and quality of lavender oil, *Scientific papers of UFT-Plovdiv, 5(1),* 2007, p: 275-280.

[4] Georgiev, E., Stoyanova, A. Handbook of the specialist in the aromatic industry, Plovdiv, 2006, BNAEOPC.

[5] Stoyanova, A. Study on the technology for the production of extracts of St. John's wort (*Hypericumperforatum* L) for cosmetic purposes, *Dissertation for the degree of "Candidate of Technical Sciences",* 1986, UFT- Plovdiv.

[6] Stoyanova, A., Georgiev, A. Technology of essential oils, *Academic Press of UFT, Plovdiv*, 2007.
[7]Balev, D.,Staykov, S., Ivanov, G., Dragoev, St.,Filizov, E. Color Stability Improvement of Chilled Beef by Natural Antioxidant Treatment and Modified Atmosphere Packaging. *A. J. Food Techn, 6*, 2011, p:117–128.
[8]Carpenter, R.P., Lyyon, D.H.,Hasell, T.A. Guidelines for Sensory Analysis in Food Product Development and Quality Control, second ed.,*An Aspen Publication*, 2000.
[9]Herbert St.,Sidel, J. Quantitative Descriptive Analysis: Development, Applications, and the Future,*Food Technology*,*52 (8)*, 1998, p:48-52.
[10]Inguglia, E.,Zhang, Z., Burgess, C., Kerry, J. Influence of extrinsic operational parameters on salt diffusion during ultrasound assisted meat curing,*Ultrasonics, 83*, 2018, p: 164–170.
[11]ISO5492:1997Sensory analysis-dictionary, ISSN 2285–1364.
[12]ISO13301-1:2000, Sensory Analysis-General Guidance for the Staff of Sensory Evaluation Laboratory, Part 1: Staff Responsibilities. WD2000.
[13] Lyon B. G., Smith, D. P., Savage, E. M. Descriptive Sensory Analysis of Broiler Breast Fillets Marinatedin Phosphate, Salt, and Acid Solutions, *Poultry Science*,*84*, 2005, p:345–349.
[14]Maxwell A.D.,Bowker, B. C., Zhuang, H., Chatterjee, D., Adhikari, K. (2018).Descriptive sensory analysis of marinated and non-marinated wooden breastfillet portions,*Poultry Science*,*97*, 2018, p:2971–2978.
[15]. Purslow, P. P.Intramuscular connective tissue and its role inmeat quality,*Meat Science*,*70*, 2005, p:435–447.
[16]Perisic, N.,Afseth, N., Ofstad, R., Narum, B., Kohler, A. Characterizing salt substitution in beef meat processing by vibrational spectroscopy and sensory analysis,*Meat Science*,*95*, 2013, p: 576–585.
[17]Sheard, P.Tali, A. Injection of salt, tripolyphosphate and bicarbonate marinade solutions to improve the yield and tenderness of cooked pork loin,*Meat Science*,*68*, 2004, p: 305–311.
[18]Vlahova-Vangelova, D.,Balev, D., Dragoev, St. Effect Of Acid Marinating With Sodium Lactate On Morphological Changes In M. Longissimus Dorsi,*Agricultural Sciences, V(14)*, 2013, p: 151-155.
[19]Vlahova-Vangelova, D.,Dragoev, St. Marination: Effect On Meat Safety And Human Health. Bulgarian, *Journal of Agricultural Science*,*20 (3)*, 2014a, p: 503–509.
[20]Vlahova-Vangelova, D., Abjanova, Sh., Dragoev, St.. Influence of The Marinating Type On The Morphological And Sensory Properties Of Horse Meat,*Acta Scientiarum Polonorum Technologia Alimentaria*,*13(4)*, 2014b, p: 403–411.