

The influence of spices from family Lamiaceae on the flavor attributes of cooked meat

Stankov¹ S., Fidan^{1*} H., Dimitrova² E.

¹Department of Nutrition and Tourism

²Department of Informatics and Statistics

^{1,2}University of Food Technologies, Plovdiv, Bulgaria

*Corresponding author: hafizefidan@abv.bg

Abstract — The aim of this study is to examine the application of fresh, dry and frozen spices from the Lamiaceae family and the way of how they influence on the flavor attributes of cooked pork meat (*m. Longissimus dorsi*). The results show that after refrigeration, the characteristics of flavor and consistency of meat seasoned with frozen thyme (*Thymus vulgaris* L.) were severely reduced, while the highest flavor values were obtained for the sample seasoned with dried thyme. Samples spiced with rosemary (*Rosmarinus officinalis* L.) exhibit the best stability of flavor indicator variation. Samples seasoned with spearmint (*Mentha spicata* L.) show higher flavor values when using the frozen seasoning compared to dry spices. The reported flavor and taste values for dry basil (*Ocimum basilicum* L.) are lower than those of the frozen spice. The study confirms the influence of the chosen method of preserving fresh spices on the aroma flavor attributes of cooked meat.

Keywords— *m. Longissimus dorsi*, *Thymus vulgaris* L., *Rosmarinus officinalis* L., *Mentha spicata* L., *Ocimum basilicum* L., Flavor attributes

INTRODUCTION

Consumption of meat is taking up a wider share of people's diet due to practicality of preparation and a number of traditions and eating habits. It is a good source of essential amino acids, proteins, vitamins and minerals [1, 2].

Several studies summarize sensory traits of various meat products [3, 4]. An important role in the formation of the organoleptic characteristics of the meat products is played by the method of heat treatment [5, 6] and the heating temperature [3]. Pretreatment with salting ingredients and fresh spices has a decisive part in sensory evaluation [7]. Using different spices (roots, leaves, seeds, fruits) contributes to the aromatic potential of meat products [4].

According to a number of researchers [8, 9] the use of natural spices provides antibacterial and antioxidant properties of food products. Du and Li, [2008] consider that the use of fresh, dry and frozen spices is restricted due to their influence on the taste and nutrition habits [1]. Chefs choose spices for accompanying the taste of

the meat dish [3], guaranteeing the desired texture and taste. Significant influence on the sensory characteristics of meat products is also the species [10] and the quantity [11] of the plant applied.

It is known that the use of fresh, dry and frozen spices enhance the antioxidant properties of the meat due to the presence of polyphenols, flavonoids, lignans and terpenoids in their content [9]. The plant essential oils (EOs) determine not only the flavor [4], but also the texture of the meat products [6]. Their inclusion in meat products increases the antioxidant potential of cooked pork [12], beef [13] and lamb [14].

The linalool in basil [9] thymol and eugenol, containing in thyme comparable to α -tocopherol, increase antioxidant properties while affecting the water-holding ability of meat [6].

Rosemary is widely used in meat dishes [15], known as a natural antioxidant. Spices used in certain concentrations may activate the activity of their own enzymes [12], assisting encoloring and water retention processes [13] that determine the quality of the end product. A number of researchers [16, 17] consider that juiciness and tenderness of meat are the factors with greatest impact on consumer assessment. The quality of meat products offered in restaurants can generally be defined as a set of sensory indicators such as colour, juiciness, tenderness, taste and flavor [11, 18].

The use of spices with different flavor properties in the culinary practice is a subject of in-depth studies. The methods of their preservation are an important technological step in the production of high quality flavorings in the production of meat culinary products.

Due to the limited studies on the application and sensory potential of dry and frozen spices in the culinary practice, the aim of this study was to analyze the possibilities of applying dry and frozen spices of the Lamiaceae family and their impact on the aromatic indicators of meat culinary products.

MATERIALS AND METHODS

Pork meat (*m. Longissimus dorsi*) was supplied by a local enterprise for pork meat processing. The meat was refrigerated at 2.0 ± 1.0 °C, packed in permeable polyethylene packages. It was reported pH 5.5-5.7 of the meat.

The raw materials used for marinating were sodium chloride, ground pepper (*Piper nigrum* L.), and sunflower oil.

Fresh herbs from the family Lamiaceae - garden thyme (*Thymus vulgaris* L.), rosemary (*Rosmarinus officinalis* L.), spearmint (*Mentha spicata* L.) and sweet basil (*Ocimum basilicum* L.) were purchased commercially.

Dry samples were obtained after fresh spices (75% relative humidity) were dried at 18 ± 2 °C to 10% relative humidity. Frozen samples were obtained after packaging under vacuum and refrigerated at -25 ± 2 °C for 72 hours.

PRE-TREATMENT AND COOKING PROCESS

Sixty samples of preliminary cut meat samples with a mass of 200 ± 0.15 g were prepared. Each sample is subjected to dry marinating with salt and ground pepper in quantity of 0.1% of the mass of the meat product. The quantities of fresh, dry and frozen spices are 0.01% of the mass of the meat product, as the spices were mechanically crushed and manually distributed on the surface of the meat product. For uniform distribution of spices on the surface of the meat samples, sunflower oil is applied, which is mechanically distributed on the surface of the samples. The prepared samples are packaged in vacuum packs and stored for 6 hours at 3.0 ± 1.0 °C in a refrigerator.

The heat treatment of the samples is carried out on a ribbed heating surface at a heating surface temperature of 270 ± 5 °C when the sample is heated on both sides. Meat products are heated to 75 °C in the center of the product with a 12-second hold.

SENSORY EVALUATIONS

The descriptive test for a quantitative sensory profiling was used to establish the sensory characteristics of the cooked meat. Fifteen trained panellists were selected to guarantee the evaluation accuracy. The intensity of each sensory characteristic was recorded on a ten-point linear scale after 1 h orientation sessions of the panellists, where they specified terminology and anchor points on the scale. The coded samples were shown simultaneously and evaluated in random order among the panellists. During the evaluation, the panellists were spread out in separate light-well cabins. Each of them had distilled water and bread biscuits without salt. The sensory evaluation was carried out in two stages: a visual assessment of the cooked meat and an evaluation of the organoleptic characteristics of each sample. Each sample was evaluated immediately after roasting [19].

STATISTICAL ANALYSIS

In order to choose the appropriate method for statistical analysis, a test for normal distribution was performed. Since the samples were small ($n=15$), the empirical criteria was implied. It showed that most of the samples were not from normally distributed populations. Hence the non-parametrical Friedman test was used in order to conduct the comparisons. The last column of Table 1 represents the p-values of the test. Those of them followed by S are less than the significance level $\alpha=0.05$, which means that there is a

significant difference between the ratings on the corresponding row (Figure 1).

The data were analyzed and presented as mean values \pm standard deviation.

RESULTS AND DISCUSSIONS

The process of extracting the aromatic substances from the spices depends on a number of factors as temperature, duration, spice type: solution ratio, composition and properties of the meat product, etc., which is a prerequisite for determining an optimal processing regime.

Figure 1(a,b,c,d) shows results for the appearance, flavor, taste and consistency of fresh, dry and frozen garden thyme, rosemary, spearmint and sweet basil. The level of significance was $\alpha=0.05$.

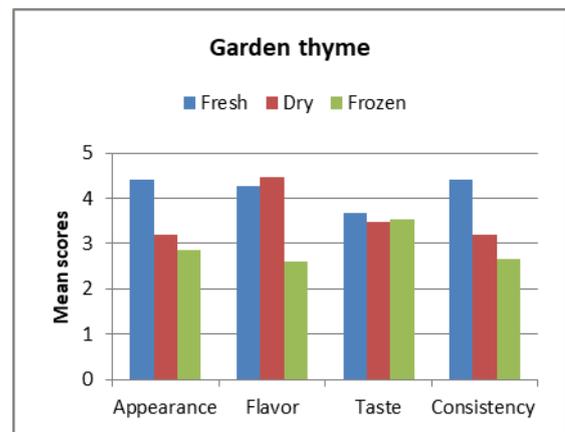


Fig. 1a. The mean scores of the appearance, flavor, taste and consistency of fresh, dry and frozen garden thyme

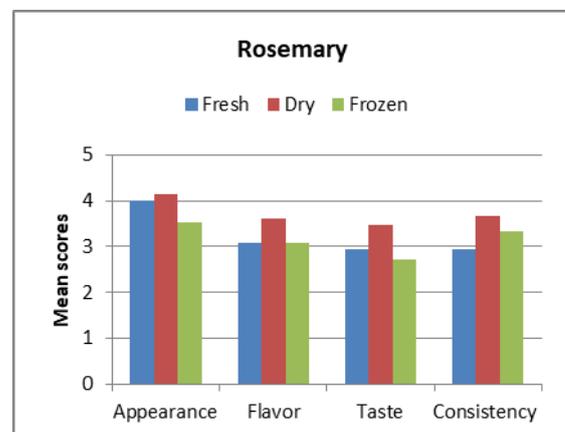


Fig. 1b. The mean scores of the appearance, flavor, taste and consistency of fresh, dry and frozen rosemary

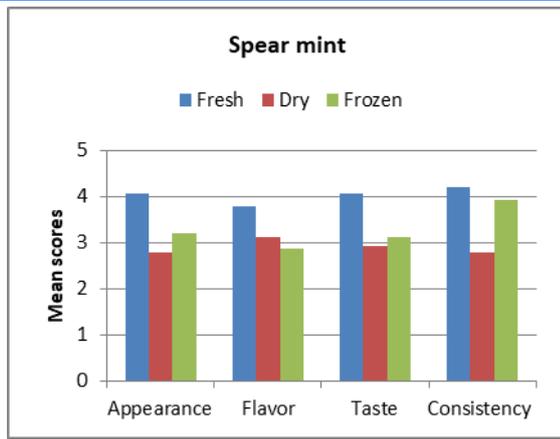


Fig. 1c. The mean scores of the appearance, flavor, taste and consistency of fresh, dry and frozen spearmint

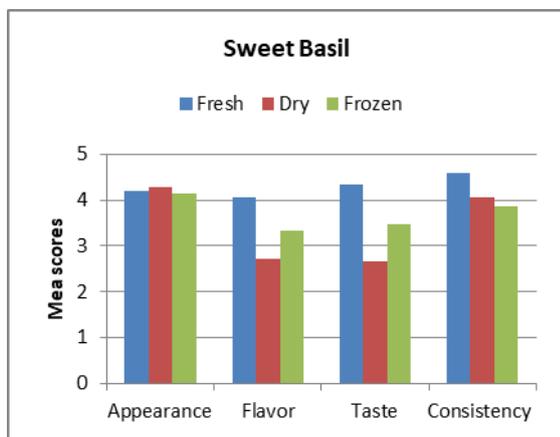


Fig. 1d. The mean scores of the appearance, flavor, taste and consistency of fresh, dry and frozen sweet basil

According to the sensory evaluation (Figure 1), it is observed that the highest value for the appearance of the meat sample is obtained with fresh thyme (4.40±0.63), while lowest mean values were recorded for sample seasoned with fresh rosemary (4.00±0.76).

The spice EOs influence on the flavor indicators of the cooked meat [20, 21].

Thyme EO contains thymol (30-40%) that is responsible for the specific flavor of the seasoning [22, 23]. Decreased aroma values may be explained by the presence of exogenous ether-oil compartments which, upon freezing, are destroyed by the formation of large crystals. Raising the temperature at the surface of the product increases the extractable substances. Increasing the extraction rate of the aromatic components reduces the adsorption processes in the raw material, resulting in the increase of the EO concentration on the product surface. When recording the flavor indicator, the highest average value for fresh spices was obtained with fresh thyme (4.27±0.96) and the lowest for fresh rosemary (3.07±1.10).

Rosemary EO contains 1,8-cineole (15-25%) and (+)-camphor (15-20%), which defines the camphorous smell of the oil [24], confirms that our findings are consistent with previous results [1] about the uncharacteristic flavor of rosemary used for seasoning of pork meat products.

Spear mint EO contains (-)-carvone (30-55%) and limonene (10-15%), substances that determine the specific flavor of the seasoning [25]. Lower values for the consistency indicator were obtained when using the dry seasoning. The dry texture of the meat product may be due to a change in the chemical composition of the essential oil, which causes additional dehydration causing the dryness of the meat.

The contents of b-linalool (28-35%) and methylchavicol (10-15%), determine the specific aroma of basil [26]. With the highest value for the taste indicator, was recorded the sample seasoned with fresh basil (4.33±0.49), while mean value for sample with dry basil was lower (2.67±0.82). The reported lower flavor value when using dry basil can be associated with the superficial thin layer of exogenous EO cells which readily release their aromatic flavor components when drying. Highest values for the changes in the consistency of meat products were reported for the sample with fresh basil (4.60±0.51).

Lower consistency values are indicated for frozen thyme samples (2.67±0.82). It is observed that the taste indicator values of dry basil and rosemary are rising. The graphs show that the flavor of dry rosemary (3.60±0.63) is more pronounced than the flavor of the fresh spice (3.07±1.10).

The mean scores for each combination of spices and their attributes are represented in Table 1.

TABLE 1. Mean scores of sensory attributes of fresh, dry and frozen garden thyme, rosemary, spear mint and sweet basil

Spice	Attribute	CONDITION			p-values for Friedman test
		Fresh	Dry	Frozen	
Garden thyme	Appearance	4.40±0.63	3.2±1.15a	2.87±0.99 a	0.0077 S
	Flavor	4.27±0.9a	4.47±0.64 a	2.60±0.91	0.0004 S
	Taste	3.67±0.6a	3.47±1.41 a	3.53±1.06 a	0.8899
	Consistency	4.40±0.74	3.20±0.77 a	2.67±0.82 a	0.0013 S
Rosemary	Appearance	4.00±0.7a	4.13±0.74 a	3.53±1.06 a	0.4884
	Flavor	3.07±1.10a	3.60±0.63 a	3.07±0.88 a	0.2865
	Taste	2.93±1.10a	3.47±0.92 a	2.73±0.80 a	0.1204
	Consistency	2.93±0.80 a	3.67±1.11 a	3.33±0.72 a	0.0986
Spear mint	Appearance	4.07±0.96 a	2.80±0.68 b	3.20±0.68 ab	0.0235 S
	Flavor	3.80±1.01 a	3.13±0.83 a	2.87±1.06 a	0.0807
	Taste	4.07±0.70	2.93±0.88 a	3.13±1.06 a	0.0044 S
	Consistency	4.20±0.68 a	2.80±1.08	3.93±1.16 a	0.0099 S
Sweet basil	Appearance	4.20±0.68*a**	4.27±0.80 a	4.13±0.64 a	0.9512
	Flavor	4.07±0.70	2.73±0.70	3.33±0.62	0.081 S***
	Taste	4.33±0.49	2.67±0.82	3.47±0.64	0.0004 S
	Consistency	4.60±0.51 a	4.07±0.88 a	3.87±0.99 a	0.1204

Note: *Values are mean score ± standard deviation; ** Means followed by the same lower case letters in a row do not differ significantly by the LSD test (p<0.05); ***p-values followed by S are less than α=0.05, which means that there is a significant difference between the mean scores on the corresponding row according to the Friedman test (p<0.05).

The probable increase may be associated with an increase in the concentration of aromatic compounds contained in the EO of spices during drying. The high temperature of the surface heating of the meat product, the presence of exudate formed as a result of marinating, is likely to cause a uniform distribution of the aromatic components throughout the meat surface. The uncharacteristic taste of dry mint and thyme can be taken into account with the differences in the method of heating of meat products [5].

The results can be seen in Table 1, where means followed by the same lower case letters in a row do not differ significantly. The flavor ratings differ significantly for the three conditions of the basil, as well as the ratings of the basil's taste. There are not differences in the appearance between the fresh and the frozen mint and between the dry and the frozen one, whereas the fresh and dry mint appearances differ significantly. Finally the thyme's dry and frozen samples do not differ in their appearance but there are significant differences between the fresh and dried and between fresh and frozen conditions of the thyme.

It was reported dependence between the type and conditions of the spices. It could be indicated that the EOs contained in each of the spices may change the sensory characteristics of the meat product.

CONCLUSION

The present study summarizes the significance of the use of various spices from the Lamiacea family used as a flavoring ingredients in pork meat products. The effects of preserving fresh seasonings through drying and freezing have been studied. The study demonstrates that thyme and rosemary are among the spices suitable for drying due to their positive influence on the aroma, taste and consistency of the end product. Results show that spear mint and sweet basil are more suitable for preservation by freezing because they possess better values of flavor and taste traits. Subject to in-depth study would be focused on the modification of the chemical constituents of the EO during drying and freezing process in order to analyze in detail the reasons for the aroma flavor changes when used in culinary practices.

REFERENCES

[1] M. De Castro, C.R. Ana, F. Reis, and B. Vicente. "Meat nutritional composition and nutritive role in the human diet." *Meat Science*, vol. 93, 3, pp. 586-592, 2013.

[2] P.M. Pereira and A.F. Vicente. "Meat nutritional composition and nutritive role in the human diet". *Meat Science*, vol. 93, 3, pp. 586-592, 2013.

[3] N.J. King and R. Whyte, R. "Does it look cooked? a review of factors that influence cooked meat color." *J Food Sci* vol., 71, 4, pp. 31-40, 2006.

[4] R. Miller. "Functionality of non-meat ingredients used in enhanced pork – Pork quality". In: National Pork Board, AMSA, pp. 1-12, 1998.

[5] C. Bejerholm and M.D. Aaslyng. "Cooking of meat. Encyclopedia of meat sciences". Elsevier

Science and Technology, Philadelphia, pp. 343-349, 2004.

[6] M. Juarez, N. Aldaip, O. Lopez-Camposp, M.E.R. Duganpp, B. Uttaro and J.L. Aalhus. "Beef texture and juiciness". [In: Hui YH (ed) *Handbook of meat and meat processing*, 2nd edn. CRC Press, Boca Raton, pp.177-206, 2012].

[7] D. Vlahova-Vangelova and S. Dragoev. "Marination: effect on meat safety and human health." *A Review. Bulgarian, J Agr Sci*, vol. 20, 3, pp. 503-509, 2014.

[8] N. Benhammou, F.A. Bekkara and T.K. Panovska. "Antioxidant activity of methanolic extracts and some bioactive compounds of *Atriplex halimus*." *Comptes Rendus Chimie*, vol. 12, pp. 1259-1266, 2009.

[9] X. L. Qing and L.C. Chiou. "Basil (*Ocimum basilicum* L.) Oils" [In book: *Essential Oils in Food Preservation, Flavor and Safety*, 2016].

[10] A. Akbulut, H. Gulhan, H. Coklar, H., I. Alhasan and S.R. Hosseini. "Purple basil (*Ocimum basilicum* L.) sorbet." [International Symposium on Medicinal, Aromatic and Dye Plants At: Malatya, Turkey, 2017].

[11] L. Karre, K. Lopez and J.K. Getty. "Natural antioxidants in meat and poultry products." *Meat Science*, vol. 94, 2, pp. 220-227, 2013.

[12] S.Y. Park, S.S. Yoo, S.S. and K.B. Chin. "Physicochemical properties, and antioxidant and antimicrobial effects of garlic and onion powder in fresh pork belly and loin during refrigerated storage." *J Food Sci*, vol. 73, pp. 577-584, 2008.

[13] H. Du and H., Li. "Antioxidant effect of Cassia essential oil on deep-fried beef during the frying process." *Meat Science*, vol. 78, pp. 461-468, 2008.

[14] K. Jayathilakan, G.K. Sharma, K. Radhakrishna and A.S. Bawa. "Antioxidant potential of synthetic and natural antioxidants and its effect on warmed-over-flavour in different species of meat." *Food Chemistry*, vol. 105, pp. 908-916, 2008.

[15] M.C. Rojas and M.S. Brewer. "Effect of natural antioxidants on oxidative stability of frozen, vacuum-packaged beef and pork." *Journal of Food Quality*, vol. 31, pp. 173-188, 2008.

[16] K.L. Huffman, M.F. Miller, L.C. Hoover, C.K. Wu, H.C. Brittin and C.B. Ramsey. "Effect of beef tenderness on consumer satisfaction with steaks consumed in the home and restaurant." *J Anim Sci*, vol. 74, 1, pp. 91-97, 1996.

[17] E.J. Delgado, M.S. Rubio, F.A. Iturbe, R.D. Mendez, L. Cassis, and R. Rosiles, "Composition and quality of Mexican and imported retail beef in Mexico." *Meat Sci*, vol. 69, 3, pp. 465-471, 2005.

[18] K. Thongtanrarns, B. Tomawendy and Z. Reiboldtahmed. "Effect of rosemary extract on lipid oxidation and sensory evaluation of frozen, precooked beef patties." *Food Res Int*, vol. 16, 34, pp. 93-104, 2005.

[19] M.C. Meilgaard, G.V. Civille and B.T.Carr. "Sensory evaluation techniques." [4th ed. Boca Raton, FL: CRC Press., 2006].

[20] G. Akarca, A. Çağlar and O. Tomar. "The effects of spicing on quality of mozzarella cheese." *Mljekarstvo*, vol. 66, pp. 112-121, 2016.

[21] L. Cornara, A. La Rocca, S. Marsili and M.G. Mariotti. "Traditional uses of plants in the eastern Riviera (Liguria, Italy)." J Ethnopharmacol., vol. 125, pp.16-30, 2000.

[22] K. Alireza, H. Faeghe, S. Siamak and B. Negar. "Study of the effect of extract of *Thymus vulgaris* on anxiety in male rats." J Tradit Complement Med, pp. 1-5, 2015.

[23] A. Wesolowska, M. Grzeszczuk and D. Jadczyk. "Comparison of the chemical composition of essential oils isolated by water-steam distillation and hydrodistillation from garden thyme (*Thymus vulgaris* L.)." J Essent Oil Bear P, vol. 19, 4, pp. 832-842, 2016.

[24] S. Djeddi, N. Bouchenah, I. Settar, and H. Skaltsa. "Composition and antimicrobial activity of the essential oil of *Rosmarinus officinalis* from Algeria." Chem Nat Comp. vol. 43, 4, pp. 487-490, 2007.

[25] S.P. Kanatt, R. Chander and A. Sharma. "Antioxidant potential of mint (*Mentha spicata* L.) in radiation-processed lamb meat." Food Chemistry, vol. 100, pp. 451-458, 2007.

[26] O. Politeo, M. Jukic and M. Milos, M. "Chemical composition and antioxidant capacity of free volatile aglycones from basil (*Ocimum basilicum* L.) compared with its essential oil." Food Chemistry, vol. 101, pp. 379-385, 2007.