A study concerning the quality of spices processed in a profile unit

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Abstract
Along with mankind evolution, the food needs of the population have turned to improved nutrition, which led to the use of spices to enhance the taste and flavour of dishes. Thus, the food industry is currently confronted with the problem of meeting consumer demands, and is trying to respond positively to their specific food requirements. Besides the aromatization function of the dishes, some spices have antiseptic and antioxidant properties, favouring digestion as well. In the present study, the qualitative analysis of spices used in the meat processing industry was followed and some of the spices used in a meat processing unit being also presented. A number of 30 spice samples represented by pepper, sweet paprika, granulated garlic and thyme were analysed, organoleptically, physicochemically (moisture, granulation, percentage of impurities, heavy metal residues and mycotoxins) and microbiological (NTG, Salmonella spp., E. coli, Enterobacteriaceae, yeasts and moulds). Regarding organoleptic parameters, the spices taken in the study are in accordance with the manufacturer's specifications, being in line with the legal provisions in force. Following the analysis of the physico-chemical parameters of the spices, no exceedances of standard values were observed, the products complying with the provisions imposed by current legislation. A medium moisture value of 5.03% was recorded for the grinded white pepper, and 4.1% for sweet paprika, both being within the admissible values. For six samples of sweet paprika were analysed included contaminants (Pb, Cd, Aflatoxin B, Ochratoxin A), the results being within the limits of admissibility, according to Regulations (EC) in force (Regulation EC No. 1881/2006, Regulation EC No. 165/2010, Regulation EC No. 594/2012). Regarding microbiological parameters, all analysed samples recorded values corresponding to the legal admissibility limits. As a result of the study, it has been found that a wide range of spices is used in the food industry and the programs of self-control and official control are respected and the results obtained are in line with the regulations in force.
Key words: *spices, flavour, mycotoxins, sweet paprika, heavy metal residues.*

Introduction

The food ingredient with flavoring properties is a food ingredient other than flavorings, that can be added to the food for the main purpose of adding or modifying the flavor (EC Regulation 1334/2008).

Depending on their nature, spices can come from the whole plant, leaves, flower buds, fruits, seeds, bark, and depending on the main action they can be flavored, spicy or allium (Banu C., 1997; Bărbulescu G., 2003; Petcu C.D., 2015).

The most commonly used spices in the meat products industry are: pepper, sweet paprika, chilli, nutmeg, cilantro, ginger, marjoram, onion and garlic. Usually, in the meat industry, ground spices are used, with particles of 0.1-1mm in size.

Chicken remains the main source of meat and requires some spices to be adapted to different culinary varieties: pepper, basil, rosemary, oregano, bay, dill, sage, thyme, cilantro, ginger, garlic, tarragon, parsley.

On the other hand, the spices used in the preparation of pork, gain a lot of attention. They differ depending on continent, eating habits and religious precepts and are represented by: pepper, garlic, thyme, cilantro, anise, ginger, dill, tarragon, fennel, sage.

Lamb meat is preferred by Muslim consumers and can be seasoned with thyme, pepper, sage, rosemary, basil, parsley, marjoram, nutmeg, mint, saffron, bay, cilantro (Enescu C., 2015).

When preparing beef, culinary specialists recommend enhancing the taste with spices and flavoring herbs. The most commonly used spices for beef are: pepper, basil, mustard, oregano, parsley, cumin, tarragon, allspice, rosemary, thyme, garlic, marjoram, onion and horseradish (Enescu C., 2015).

Materials and methods

In the present study, the qualitative analysis of spices used in the meat processing industry was followed and some of the spices used in a meat processing unit being also presented.

A number of 30 spice samples represented by pepper, sweet paprika, granulated garlic and thyme were analysed, organoleptically, physicochemically (moisture, granulation, percentage of impurities, heavy metal residues and mycotoxins) and microbiological (NTG, Salmonella spp., E. coli, Enterobacteriaceae, yeasts and moulds).

It was followed the compliance of the parameters of the analyzed spice samples, the results obtained being compared with the values stipulated in the manufacturer's specifications, being in line with the legal provisions in force.

The analysis methods used are the reference methods, described in specific standards.

The spice samples were collected from a profile unit in our country, provenance or geographical origin being different. The collected samples were analyzed in the factory's own laboratory and in external laboratories.

Results and discussions

Physico-chemical parameters followed were: moisture, granulation, percentage of impurities, heavy metal residues and mycotoxins.

Among the microbiological parameters addressed for spices, the NTG, the presence or absence of *Salmonella spp*., *E. coli*, *Enterobacteriaceae*, yeasts and moulds were examined to determine the classification of the spices under the admissibility conditions required by the legal provisions in force (Regulation EC No. 2073/2005).

Before being added to meat products, the spices are subjected to the organoleptic examination, aspects concerning taste, smell, colour and texture being followed.

Results and discussions on laboratory analysis of black pepper

Black pepper (*Fam. Piperaceae; Piper nigrum L.*)

Pepper is the fruit of a wallflower with red fruits. Today, it is found in several forms: black pepper (strong taste), green pepper (pepper that has not reached maturity), white pepper (ripe fruit, peeled). Commercially, black pepper is found in the form of berries with a wrinkled pericard, the colour varies from dark gray to dark brown (Constantinescu Ș. et al., 1966).

It is often used in meat products: frankfurters, fresh pork sausages, salami, Italian sausages and ham (Kenneth T.F., 1999). Pepper is one of the condiments that can be thermally processed for a long time, without depreciating it, from a sensory point of view (table 1).

Table 1. Description of black pepper

Product description	Whole black pepper is the whole dry berry of *Piper nigrum L.*, generally picked before complete ripening. Berries of black pepper generally have a diameter of 3 mm to 6 mm and are brown, grey or black in colour with a wrinkled pericard.
Botanical name	*Piper nigrum L.*
Country of origin	Vietnam
Pack size	25 kg
Shelf life from manufacture	24 months
Appearance/colour	Dried berry of *Piper nigrum L.*, having an unbroken pericarp
Flavour and odour	Spicy sharp, pungent aroma and flavour

Black pepper samples are free from mould growth and living insects and practically free from dead insects, insect fragments and rodent contamination visible to the naked eye or with such magnification as may be necessary in any particular case. If the magnification exceeds x10, this fact shall be mentioned in the test report.

The packages of pepper are stored in covered rooms, well protected from sun, rain and excessive heat. The store is dry, free from unpleasant smells and protected against penetration of insects and vermin. The ventilation is regulated so that good ventilation is ensured during the dry period.

Following the analysis of the physico-chemical parameters for 6 black pepper samples (table 2), no exceedance of the values was observed, the products complying with the provisions imposed by current legislation. An average moisture value of 6.20% was recorded, with a minimum value of 5.23 and a maximum value of 7.02, none of the values exceeding the reference value of 13%. The average value of the total ash is 5.10%, all the results obtained recorded values corresponding to the legal admissibility limits. The maximum permissible of mineral admixtures is 1% and the average value recorded is 0.11%.

Table 2. Chemical and physical standards of black pepper

Physical and chemical requirements	Reference test method		Result
Moisture	not more than 13.0 %	ISO 939:1980	6.20%
Total ash	not more than 7.0 %	ISO 928:1997	5.10%
Mineral admixtures	not more than 1.0 %	ISO 1208:1982	0.11 %
Volatile oil content on dry basis	not less than 2.0 ml/100g	ISO 6571:2009	2.08 ml/100g
Non-volatile ether extract on dry basis	not less than 6.0 ml/100g	ISO 5564:1982	6.19 ml/100g

Regarding microbiological parameters (table 3), black pepper analyzed samples recorded values corresponding to the legal admissibility limits. Negative results have been obtained regarding the presence of *Salmonella spp.*, and in the case of yeasts and moulds the results do not exceed the admissibility limits, which places the product within the limits of admissibility, according to legal provisions in force.

Table 3. Microbiological standards of black pepper

Test parameter	Reference test method		Result
E. coli	10^2 max.	ISO 9377:1885	<10 cfu/g
Salmonella spp.	Absent in 25 g	ISO 6579:2002	Absent/25.0 g
Yeasts and Moulds	10^5 cfu/g max.	ISO 7954:1987	10^4 cfu/g

Results and discussions on laboratory analysis of ground white pepper

The form of presentation of ground **white pepper** is a powder with a visible grain, gray-white color, with a slight yellowish tinge. The perceived smell is characteristic of pepper, slightly spicy, and the taste is characteristic, pleasant, slightly spicy and aromatic.

Table 4 lists the physico-chemical parameters resulting from the analysis of 6 samples of ground white pepper and the values obtained in comparison with the conditions allowed by the legislation in force are presented. The average moisture value is 5.03%, the minimum value being 4.17 and the maximum value 5.86. Extraneous matter, of vegetable or mineral origin register the average value of 0.01%.

Tabel 4. Chemical and physical standards of white pepper

Physical and chemical requirements	Reference test method		Result
Moisture	not more than 15.0 %	ISO 939:1980	5.03%
Extraneous matter*	not more than 0.1 %	ISO 927:1982	0.01%

*all materials other than black pepper berries, irrespective of whether they are of vegetable (e.g. stems and leaves) or mineral (e.g. sand) origin

Following the analysis of the microbiological parameters of the ground white pepper (table 5), it is found that the number of *Enterobacteriaceae* does not exceed the legal limit allowed by 10^3 cfu/g, the average result obtained being 253 cfu/g, with a minimum value of 201 cfu/g and a maximum value of 304 cfu/g. The result of the yeasts and moulds parameter confirms that this assortment of spice meets the requirements of use according to the legislation in force.

Tabel 5. Microbiological standards of white pepper

Test parameter	Reference test method	Result
Enterobacteriaceae	10^3 cfu/g max.	253 cfu/g
Yeasts and Moulds	10^6 cfu/g max.	600.000 cfu/g

Results and discussions on laboratory analysis of sweet paprika powder

Sweet paprika comes from the *Capsicum annum* species and is another condiment used in the finished meat products of the study unit.

This spice is presented as a fine powder, of intense red colour. Following the organoleptic examination (table 6) it was found that the smell of this spice is pleasant, characteristic of paprika and its taste is sweet.

Table 6. Description of sweet paprika powder

Product description	The sweet paprika powder is product obtained of ripe fruits of *Capsicum annum L.* after cleaning, drying and grounding to powder with particles size passed through sieve mesh 70.
Botanical name	*Capsicum annuum*
Country of origin	China
Pack size	25 kg
Shelf life from manufacture	24 months
Appearance/colour	Red colour with hue depended of natural coloring matter content
Odour	Characteristic of paprika and free from foreign odours and off-odours
Flavour	Typical of paprika, sweet, warm, slightly acid and free from foreign flavours

The physico-chemical parameters for the samples of the sweet pepper are presented in table 7, not exceeding the values, the product respecting the provisions imposed by the legislation in force. The average result of the moisture is 4.12%, none of the 6 samples not exceeding the maximum limit imposed by 11.0%. The average value of the total ash is 4.07%, the minimum value obtained is 3.02% and the maximum value 5.09%. Capsaicin content is within the legal limits, the result being 20 μg/g.

Tabel 7. Physical and chemical standards for sweet paprika powder

Physical and chemical requirements	Reference test method		Result
Moisture	Not more than 11.0%	ISO 7540:2009	4.12%
Total ash	Not more than 8.0%	ISO 928:1997	4.07%
Degree of fineness: pass through sieve 70 mesh	Not less than 92%	ISO 3588:1997	95%
Non volatile ether extract	Not more than 17.0%	ISO 1108:1992	13.35%
Capsaicin content	Not more than 30 μg/g	ISO 7540:2006	20 μg/g

The microbiological parameters for sweet paprika powder (table 8) have obtained negative results regarding the presence of *Salmonella spp.* and *E. coli* and the result of the yeasts and moluds does not exceed the admissibility limits, which falls within the limits imposed by the legislation in force.

Table 8. Microbiological standards for sweet paprika powder

Test parameter	Reference test method		Result
E. coli	10^2 max.	ISO 9377:1885	<10 cfu/g
Salmonella spp.	Absent	ISO 6579:2002	Absent/25.0 g
Yeasts and Moulds	10^5 cfu/g max.	ISO 7954:1987	$8,7*10^4$ cfu/g

For six samples of sweet paprika were analysed included contaminants (Pb, Cd, Aflatoxin B, Ochratoxin A), the results being within the limits of admissibility, according to Regulations

(EC) in force (Regulation EC No. 1881/2006, Regulation EC No. 165/2010, Regulation EC No. 594/2012, Regulation EC No. 396/2005) (table 9).

Table 9. Contaminants from the sweet paprika powder samples

Test parameter	Reference test method	
Lead (Pb)	Not more than 3.0 mg/kg	Product complies Regulation (EC) No. 1881/2006
Cadmium (Cd)	Not more than 2.0 mg/kg	Product complies Regulation (EC) No. 1881/2006
Aflatoxins B	Not more than 5 μg/kg	Product complies Regulation (EC) No. 165/2010
Total Aflatoxins	Not more than 10 μg/kg	Product complies Regulation (EC) No. 165/2010
Ochratoxin A	Not more than 20 μg/kg	Product complies Regulation (EC) No. 594/2012
Pesticide maximum residues levels	Not more than 0.01 mg/kg	Limits comply Regulation (EC) No. 396/2005 and latest Regulations

Results and discussions on laboratory analysis of granulated garlic

Granulated garlic is obtained from freshly dried and milled garlic, after having it previously cleaned of shells and roots. It comes in the form of garlic granules, with a uniform appearance. The colour of garlic is yellowish-white, sometimes with a slight tinge of yellow. The taste and smell of the product is pleasant, it has no smell and taste of mould or other unpleasant odour (table 10).

Table 10. Description of granulated garlic

Product description	Granules obtained by passing through the sieve freshly dried and milled garlic, after having it previously cleaned of shells and roots
Botanical name	*Allium sativum*
Country of origin	China
Pack size	12,5 kg
Shelf life from manufacture	12 months
Appearance/colour	Creamy-light brown
Odour	Characteristic of garlic and free from foreign odours and off-odours
Flavour	Typical of garlic and free from foreign flavours

Following the analysis of the physico-chemical parameters, the average result of the moisture for the 6 samples of granulated garlic is 4.01%, the minimum value being of 3.45% and the maximum value of 4.56. The average value of the total ash is 1.61% and of the ash insoluble in acid of 0.95%, the results of all samples being within the limits of admissibility. The insolubility in hot water recorded during the analysis of this spice has an average of 10%. The values obtained for these physico-chemical parameters do not show breaches of the legislation in force (table 11).

Tabel 11. Chemical and physical standards of granulated garlic

Physical and chemical requirements	Reference test method	Result
Moisture	not more than 6.0 %	4.01 %
Total ash	not more than 4.0 %	1.61 %
Ash insoluble in acid	2.5 %	0.95 %
Insolubility in hot water	20 % max.	10 %

The NTG detected in the granulated garlic samples was 250.000 cfu/g, the results beeing within the admissibility limits. The presence of *Salmonella spp.* and *E. coli* in granulated garlic was not detected, *Staphilococcus aureus* presented an average value of 15 cfu/g and *Bacillus cereus* an average value of 25 cfu/g, the results being in line with the legal provisions in force (table 12).

Tabel 12. Microbiological standards of granulated garlic

Test parameter	Reference test method	Result
NTG	300.000 cfu/g max.	250.000 cfu/g
E. coli	Absent in 10 g	Absent/10.0 g
Salmonella spp.	Absent in 25 g	Absent/25.0 g
Staphilococcus aureus	100 cfu/g max.	15 cfu/g
Bacillus cereus	100 cfu/g max.	25 cfu/g
Yeasts and Moulds	100 cfu/g max.	35 cfu/g

Results and discussions on laboratory analysis of thyme

Thyme (*Fam. Laminaceae*, *Satureja hortensis* - garden thyme; *Thymus vulgaris* – culture thyme).

Ground thyme is another condiment for processing meat assortments. This product comes in the form of a fine powder, dried green colour. For the organoleptic examination (table 13) of this product, taste and odour were analyzed. Thus, the odour is specific to thyme, pronounced spicy and the taste is pungent.

Table 13. Description of thyme

Product description	Thyme is product obtained of ripe fruits of *Satureja hortensis* or *Thymus vulgaris* after cleaning, drying and grounding to powder.
Botanical name	*Satureja hortensis, Thymus vulgaris*
Country of origin	Polonia, Romania
Pack size	15 kg
Shelf life from manufacture	12 months
Appearance/colour	Dried green
Odour	Characteristic of thyme and free from foreign odours and off-odours
Flavour	Typical of thyme and free from foreign flavours

After examining the physico-chemical parameters (table 14) for 6 thyme samples, the average value of moisture was 6%, the results of the samples falling in the range of 3-8%. Total aflatoxin recorded an average value of 5.1 ppb and Aflatoxin B_1 an average value of 1.01 ppb.

These values obtained do not show breaches of the admissibility conditions provided by the legislation in force.

Tabel 14. Results on laboratory analysis of thyme

Test parameter	Reference test method	Result
Moisture	3-8%	6.0%
Total Aflatoxins	Not more than 10 ppb	5.1 ppb
Aflatoxins B_1	Not more than 5 ppb	1.01 ppb

Regarding microbiological parameters (table 15), the number of *Enterobacteriaceae* did not exceed the limits allowed by the legislative provisions. In the examined thyme samples, the presence of *Salmonella spp.* and *E.coli* was not noted.

Tabel 15. Microbiological standards of thyme

Test parameter	Reference test method	Result
Enterobacteriaceae	10^6 cfu/g max.	5.000 cfu/g
E.coli	Absent/10 g	Absent/10 g
Salmonella	Absent/25 g	Absent/25 g

Conclusions

Regarding organoleptic parameters, the spices taken in the study are in accordance with the manufacturer's specifications, being in line with the legal provisions in force.

Following the analysis of the physico-chemical parameters of the spices, no exceedances of standard values were observed, the products complying with the provisions imposed by current legislation.

A medium moisture value of 6.20% was recorded for the black pepper, 5.03% for the grinded white pepper and 4.1% for sweet paprika, all being within the admissible values.

For sweet paprika samples were analysed included contaminants (Pb, Cd, Aflatoxin B, Ochratoxin A), the results being within the limits of admissibility, according to Regulations (EC) in force (Regulation EC No. 1881/2006, Regulation EC No. 165/2010, Regulation EC No. 594/2012).

Regarding microbiological parameters, all analyzed samples recorded values corresponding to the legal admissibility limits.

As a result of the study, it has been found that a wide range of spices is used in the food industry and the programs of self-control and official control are respected and the results obtained are in line with the European regulations in force.

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10. *** Regulamentul (CE) Nr. 2073/2005 al comisiei din 15 noiembrie 2005 privind criteriile microbiologice pentru produsele alimentare.
11. ***Regulamentul (CE) Nr. 1881/2006 al Comisiei din 19 decembrie 2006 de stabilire a nivelurilor maxime pentru anumiți contaminanți din produsele alimentare.
12. ***Regulamentul (CE) Nr. 1334/2008 al Parlamentului European și al Consiliului din 16 decembrie 2008 privind aromele și anumite ingrediente alimentare cu priprietăți aromatizante destinate utilizării în și pe produse alimentare și de modificare a Regulamentului (CE) Nr. 1601/91 al Consiliului, a Regulamentelor (CE) Nr. 2232/96 și (CE) Nr. 110/2008 și a Directivei 2000/13/CE.
13. ***Regulamentul (UE) Nr. 165/2010 al Comisiei din 26 februarie 2010 de modificare a Regulamentului (CE) nr. 1881/2006 de stabilire a nivelurilor maxime pentru anumiți contaminanți din produsele alimentare în ceea ce privește aflatoxinele.
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