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STATISTICAL PROCESSING OF THE CHEMICAL ANALYSIS OF SOME MEAT PRODUCTS

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Abstract
The inceptions of industrial meat processing on the territory of the Republic of Macedonia date from the second half of the last century. Today, there are several meat industries, which have introduced many standards for food safety. However, only one of them having set rounded products (slaughter of cattle and pigs and production of meat products) has implemented HACCP system and ISO-2001-9000. This company has its own laboratory where the raw materials and the finished product are examined. Various organoleptic, chemical and microbiological tests are commonly performed in the laboratory existing in this meat company. The above mentioned meat industry has the longest tradition in the Republic of Macedonia. The aim of this study is to monitor the quality of few chosen products (Tea Sausage, Meat Luncheon, Beef Goulash and Smoked Pork Collar) through parameters obtained by chemical analysis. Series of ten chemical analyses of chosen parameters were gathered through a longer period of time and were treated by mathematical-statistical analysis.

The obtained results show that the achieved quality fully meets the world standards for such types of meat products.

Key words: *Chemical analysis, Tea Sausage, Meat Luncheon, Beef Goulash, Smoked Pork Collar*

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СТАТИСТИЧКА ОБРАБОТКА НА ХЕМИСКИТЕ АНАЛИЗИ НА НЕКОИ ВИДОВИ МЕСО

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Апстракт

Зачетоците на месната индустрија на територијата на Република Македонија датираат од втората половина на минатиот век. Денес има повеќе месни индустрии со имплементирани стандарди за безбедност на храна, а само некои од нив (колење на говеда и свињи и производство на месни производи) имаат имплементирано HACCP систем и ISO -2001-9000 и имаат сопствени лаборатории, каде ги испитуваат суровините што се употребуваат за производите од месо, како и готовите производи (органолептички, хемиски и микробиолошки). Овие месни индустрии ја имаат и најдолгата традиција во Република Македонија. Сите хемиски анализи се направени во соодветните лаборатории.

Целта на ова истражување е да се контролира квалитетот на неколку избрани производи (чаен колбас, месен нарезок, говедски гулаш и чадено свинско месо), преку хемиски анализи и преку детерминација на варијабилноста во нивниот квалитет. Серија од десет хемиски анализи на избрани параметри се собирани во текот на подолг временски период и истите потоа се обработувани со помош на математичко-статистички методи.

Добиените резултати покажуваат дека квалитетот на испитуваните месните производи целосно ги задоволува светските стандарди за таквите видови месни производи.

Клучни зборови: *хемиски анализи, чаен колбас, месен нарезок, говедски гулаш, чадено свинско месо.*

1. Introduction

The Meat Industry and Slaughterhouse "Sveti Nikole" is a factory for processing of meat and meat products with tradition of 50 years. Following the world's achievements in production technologies and ensuring the quality of its products, it had implemented ISO 9001:2000 in 2003 and HACCP food safety system in 2005.

The quality of the finished meat products (Tea Sausage, Meat Luncheon, Beef Goulash, Smoked Pork Collar etc.) produced by Meat Industry and

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Slaughterhouse Sveti Nikole, Republic of Macedonia, is regularly monitored via microbiological, chemical and sensor analysis of the meat products.

It is well known that the mathematical-statistical analysis is an important tool for interpreting the results obtained by monitoring the quality control of the meat. The most important and most commonly used parameter in the statistical analysis is the standard deviation [1]. If the standard deviation is smaller, that much smaller is the variability of a given statistical group of data. The standard deviation along with the mean value determines whether the distribution of the statistical sum is normal [2]. Another important parameter of the statistical analysis is the variation coefficient. It is used to compare variability of two or more characteristics, i.e. the same characteristic measured in different terms.

This study gives preliminary results of the statistical processing of the chemical analysis of several meat products. The aim of this study is to show the quality of few chosen products (Tea Sausage, Meat Luncheon, Beef Goulash and Smoked Pork Collar) through chemical analysis and determine their quality variability and rank on quality (unclear sentence, please modify it)

2. Material and methods

Four meat products were chosen to be examined: Smoked Pork Collar, Meat Luncheon, Beef Goulash and Tea Sausage. During the production of these products, starting from the primary preparation and slaughtering of the animals and all through the final production of the mentioned products, all the obligatory sanitary and veterinarian measures for slaughtering, as well as the primary processing of meat and meat products have been preserved. From all these products results were collected in 10 repeated measurements of water, fat, proteins, minerals, nitrite and kitchen salt.

The quantity of the water in the products is determined by drying to a constant weight at a temperature of 105 °C[3]. To determine the quantity of fats in the final products we used the standard method based on extraction of fats by organic dissolvent in a Soxlet apparatus [3, 4]. The total amount of proteins was determined by the method of Kjeldahl [5]. The total amount of ashes (mineral materials) was determined by measuring the quantity of ashes in the samples after mineralization in a Muffle Oven at a temperature of 550-650 °C[6].

The amount of nitrites was examined by a (please refer just the name of the method). The intensity of the color is measured by a spectrophotometer at wave longitude of 439 nanometers[7].

The amount of kitchen salt was determined by treatment of 5 gr. of the sample with 20 ml of 0, 1 H solution of silver nitrate and 20 ml of nitric acid placed on a gas ring for its destruction. A satiated solution of potassium permanganate and sugar is then added till the solution becomes colorless. A 100 ml of distilled water is then added together with a phero-ammonium

sulphate as indicator. Afterwards, the solution is titrated with 0, 1 H solution of ammonium rodanide [7].

The obtained results were mathematically and statistically processed by a standard computer program, Excel, under defined statistical methods. We determined the mean values, standard deviation, variation coefficient and the presence of statistically important differences by the criteria of Duncan and Newman-Keuls [8, 9].

$$\bar{X} = \frac{\sum\limits_{i=1}^{n} X_i}{n} \qquad \sigma = \sqrt{\frac{\sum (x - \bar{x})^2}{n}} \qquad CV = \frac{\sigma}{X}$$

3. Results and discussion

The measured quantities of water and fat in the final products are shown in Figures 1 and 2, respectively. The amount of water in the Tea Sausage varies from 22,32% to 33,29% giving an average value of 28,68%. This parameter in the Meat Luncheon varied from 55,25% to 60,99% with an average value of 58,40%, while in the Beef Goulash it ranges from 60,19% to 79,11% with an average of 74,30%. The amount of fat in the Tea Sausage ranges from 28,22% to 48,28% giving an average value of 39,78%, while in the Meat Luncheon it varies from 15,22% to 18,00% giving an average value of 16,08%, and in the Beef Goulash it ranges from 5,50% to 15,50% with an average of 8,70%.

The determined amounts of total of proteins and minerals in the final products are shown in Figures 3 and 4, respectively. The amount of total proteins in the Tea Sausage gives an average values of 21, 70%, in the Meat Luncheon give an average of 14, 70%, and in the Beef Goulash gives an average of 12, 18%. The amount of minerals in the Tea Sausage has an average value of 3, 24%, while in the Meat Luncheon gives an average of 2, 99%, and in the Beef Goulash of the average values is 1, 93%.

The determined amounts of nitrite and kitchen salt in the Smoked Pork Collar are shown in Figures 5 and 6, respectively. The average value of nitrite is 3, 28mg.%, while the average of kitchen salt is 2, 76%.

The results of the statistical calculation for Meat Luncheon, Tea Sausage and Beef Goulash are given in Table 1, while the results for Smoked Pork Collar are given in Table 2.

From the results in Table 1, one can conclude that the minimal coefficients of variance exist by the Tea Sausage, while the maximum values exist by the Meat Luncheon. All sample data are relatively homogenous with low standard deviation values. This is an indicator that proves that the production was conducted in accordance to standard procedures and with standard quality raw

materials. Slight discrepancies were observed only for the Meat Luncheon regarding the parameters of water and fat (30,09 and 20,65, respectively), but they are within acceptable margins.

The results in Table 2 show that the nitrite quantities are much smaller than the permitted ones, while the kitchen salt quantities are within the normal margins. The examined samples are relatively homogenous with low standard deviation values that indicates that the production was conducted in accordance to standard procedures and with standard quality raw materials [10, 11].

4. Conclusions
From the above mentioned we could draw the following conclusions:

1. The average water quantity is 28,68 % for Tea Sausage, 58,40 % for Meat Luncheon and 74,30 % for Beef Goulash. The average fat quantity is 8,70 % for Beef Goulash, 16, 08% for Meat Luncheon and 39,78% for Tea Sausage.
2. The average protein quantity is 12,18 % for Beef Goulash, 14,70 % for Meat Luncheon and 21,70 % for Tea Sausage. The average mineral quantity is 2,28 % for Beef Goulash, 2,99 % for Meat Luncheon and 3,24 % for Tea Sausage.
3. The smallest coefficient of variance denoting the smallest variability of the statistical population is observed for the Beef Goulash for the parameter of fat 2,36, while the largest statistical variability is observed for the Meat Luncheon for the parameter of water 30,09.
4. The examined samples of Smoked Pork Collar show homogenous results for nitrite and kitchen salt quantities since the standard deviation and coefficient of variance have rather low values.

The statistical data prove that the considered meat industry produces standard meat products with top quality, thus exhibiting utmost care for the health of its consumers.

5. References
Salitrežić, T., Žugaj, M. (1985). Introduction to scientific research work, (V. izd.) FOI, Varaždin,

Šošić, I., Serdar, V.(1977). Introduction to Statistical book Zagreb school.

AOC, (1970), Official Methods of Analysis of the Assoc. of Anal. Chemists, 11 Edn. D. H. William, Washington DC., 20044

Wochs,W.,(1961),Oil undFette,Analysenahrnungsfette verlagA. W.HayneErban,1961, Berlin, 98-104.

Kjeldahl, J.C.C.T.,En my Methode til Kvaelstofbestemmelse I Organiske Stoffer, Meed. Carsberg lab.,2,1 0-27 Compt. Rend.Traw. lab.carsberg, 2, 1-12, anal. Chem. 1883, 22336-382.

Wang,FS, (2001), Lipolytic and proteolitic properties of dry cured boneless hamsripened in modified atmospheres, Mat Sience 59; 1, 15-22.

Chemical analysis of meat and meat products, (1985), Yugoslav Institute of Meat Technology

Brandt, (1979), Statistical and Computational Methods in data analysis Elsevier Publichers Co., New York, 55-101.

Georgieva , P.S. Todorinov St. Tančev(1987), Mathematical methods in statistical in technological test , Preliminary Aanalysis, Agriculltural Science, XXV, 100-109.

Rules on meat quality of cattle for slaughter (2003)

Rules for quality of meat products (2003)

Attachment
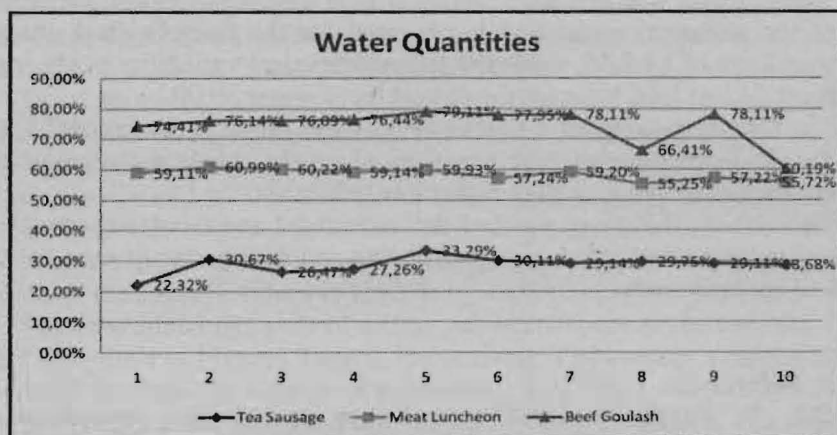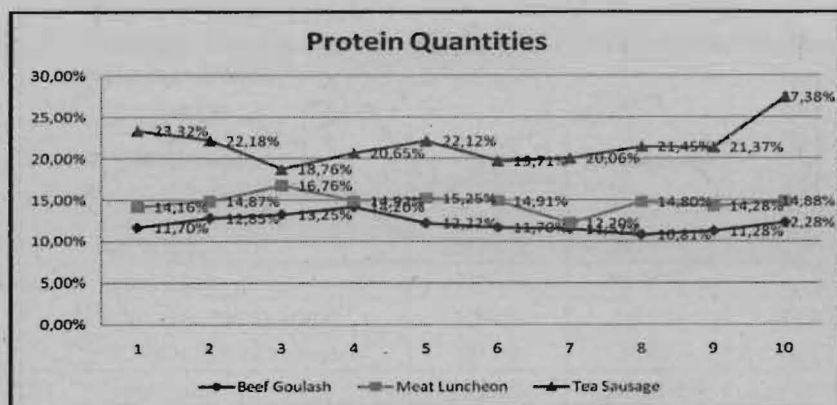

Слика 1. Дистрибуција на резултати од хемиски анализи на вода во месен нарезок, чаен колбас и говедски гулаш

Figure 1. Distribution of the results from chemical analysis of water in Meat Lucheon, Tea Sausage and Beef Goulash

Fat Quantities
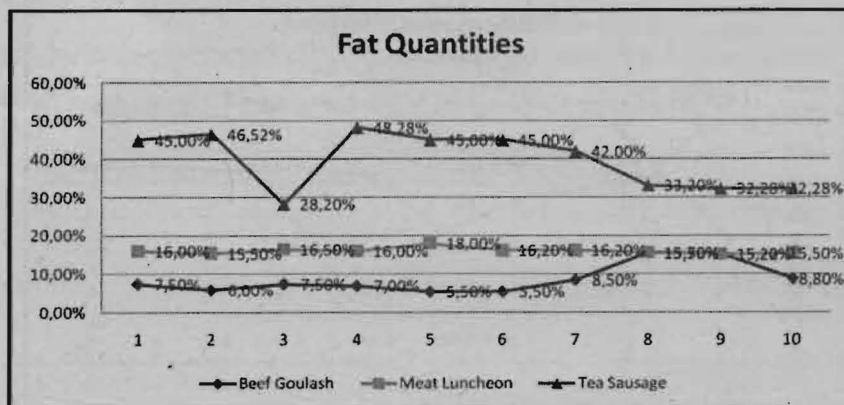
Слика 2. Дистрибуција на резултати од хемиски анализи на масти во месен
нарезок, чаен колбас и говедски гулаш

Picture 2. Distribution of the results from chemical analysis of fat in Meat Lucheon,
Tea Sausage and Beef Goulash

Protein Quantities

Слика 3. Дистрибуција на резултати од хемиски анализи на протеини во
месен нарезок, чаен колбас и говедски гулаш

Фигуре 3. Distribution of the results from chemical analysis of proteins in Meat
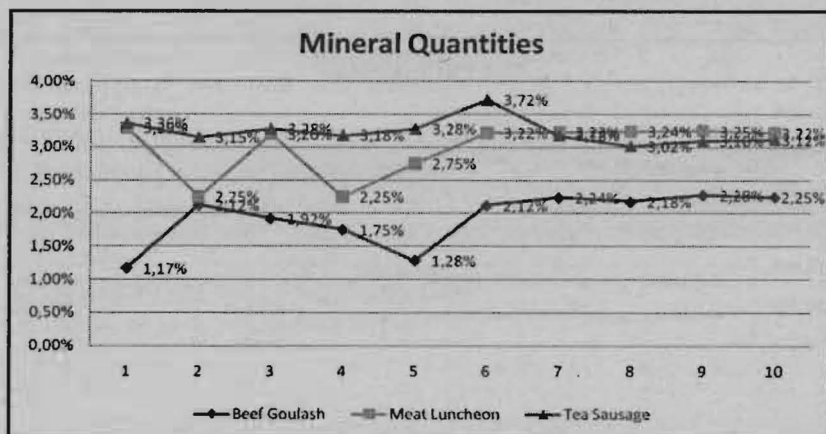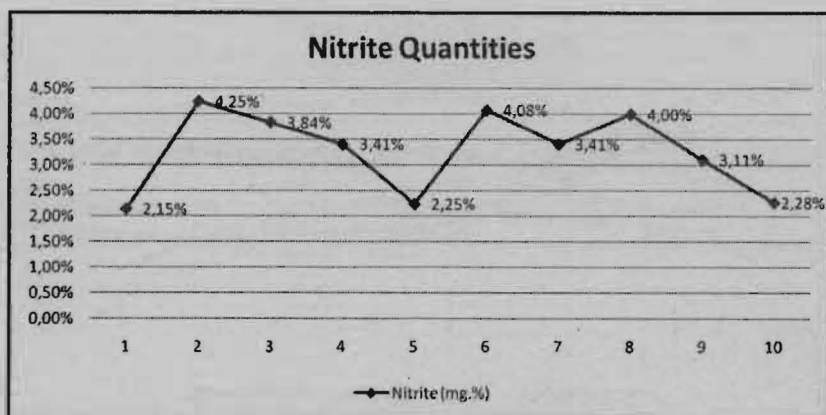Lucheon, Tea Sausage and Beef Goulash

Mineral Quantities

Beef Goulash: 1,17% ... 2,75% ... 1,92% ... 1,75% ... 1,28% ... 2,12% ... 2,14% ... 2,18% ... 2,28% ... 2,25%
Meat Luncheon: 3,36% ... 2,25% ... 2,25% ... 2,75% ... 3,22% ... 3,28% ... 3,24% ... 3,25% ... 3,22%
Tea Sausage: 3,36% ... 3,15% ... 3,28% ... 3,18% ... 3,28% ... 3,72% ... 3,02% ... 3,16% ... 3,22%

Слика 4. Дистрибуција на резултати од хемиски анализи на минерални
материи (пепел) во месен нарезок, чаен колбас и говедски гулаш

Figure 4. Distribution of the results from chemical analysis of minerals (ashes) in
Meat Lucheon, Tea Sausage and Beef Goulash

Nitrite Quantities

Nitrite (mg.%): 2,15% ... 4,25% ... 3,84% ... 3,41% ... 2,25% ... 4,08% ... 3,41% ... 4,00% ... 3,11% ... 2,28%

Слика 5. Дистрибуција на резултати од хемиски анализи на нитрати во
чадено свинско месо

Figure 5. Distribution of the results from chemical analysis of nitrite in Smoked
Pork Collar

Kitchen Salt Quantities
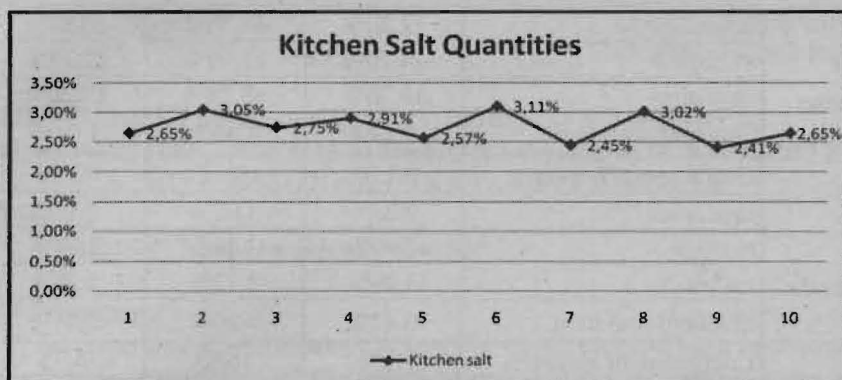
Слика 6. Дистрибуција на резултати од хемиски анализи на кујнска сол во
чадено свинско месо
Figure 6 Distribution of the results from chemical analysis of kitchen salt in
Smoked Pork Collar

Табела 1. Статистички вредности на хемиските анализи на месен нарезок,чаен
колбас и говедски гулаш
Table 1. Statistical values of the chemical analysis of Meat Lucheon, Tea Sausage
and Beef Goulash

Indicator		Meat Luncheon	Tea Sausage	Beef Goulash
Water	minimum	55,25%	22,32%	60,19%
	average	58,40%	28,68%	74,30%
	maximum	60,99%	33,29%	79,11%
	Standard deviation	1,94%	2,91%	6,13%
	Coefficient of variance	30,09	9,86	12,12
Fat	minimum	15,22%	28,20%	5,50%
	average	16,08%	39,78%	8,70%
	maximum	18,00%	48,28%	15,50%
	Standard deviation	0,78%	7,41%	3,68%
	Coefficient of variance	20,65	5,37	2,36

Proteins	minimum	12,20%	18,76%	10,81%
	average	14,70%	21,70%	12,18%
	maximum	16,76%	48,28%	14,20%
	Standard deviation	1,13%	2,40%	1,01%
	Coefficient of variance	13,05	9,04	12,00
Minerals	minimum	2,25%	3,02%	1,17%
	average	2,99%	3,24%	1,93%
	maximum	3,29%	3,72%	2,28%
	Standard deviation	0,42%	0,20%	0,41%
	Coefficient of variance	7,14	16,53	4,75

Табела 2. Статистички вредности на хемиските анализи на чадено свинско месо
Table 2.   Statistical values of the chemical analysis of Smoked Pork Collar

Indicator		Smoked Pork Collar
Nitrite	minimum	2,15mg.%
	average	3,28mg.%
	maximum	4,25mg.%
	Standard deviation	0,80%
	Coefficient of variance	4,08
Kitchen Salt	minimum	2,41%
	average	2,76%
	maximum	4,25%
	Standard deviation	0,25%
	Coefficient of variance	10,90