ABSTRACT

Quality of the nutrients from the food which we intake represent a main factor of health state. Man procures from food the necessary elements for a good function of organism form the angle of physiology and life sustain. Meat quality concept is in a continuous change also nowadays, the consumer is interested by its' influence on health state, hedonism properties, sensorial properties, easy and quick way of cooking and at last but not least by the achievement price.

Rabbit meat correspond to the actual demands of consumers, being rich in proteins with a high biological role, due to the high content in essential amino acids; also contain a reduced quantity of lipids (especially cholesterol), and its quality is superior compared with other species, by high content in monounsaturated and polyunsaturated fatty acids (especially ω3 and ω6, essential fatty acids, which have positive influences regarding the health state of human organism). Content in mineral substances is high (especially potassium, phosphorous, magnesium and sodium), as well as the one in vitamins (especially B complex and liposoluble vitamins A and E).

Another advantage of rabbit meat (in according with the studies effectuated in world), is represented by the very low content in urate, being recommended even to the persons with gout. It is necessary a profound study of those rabbit meat features, especially its high diet and nutritive-biological value, mainly in the actual period, when the so called civilization maladies, respectively cardio-vascular diseases and the metabolic ones (diabetes, gout, obesity) have an increased incidence.

The current research was focused on sensorial and nutritional quality of rabbit meat (Belgian Giant breed) in comparison with the one of hares (*Lepus Europaeus* Pallas) in correlation being realised the characterization of the morph-physiological status of them.

Characterization of rabbit meat from nutritional-biological and sensorial angle was the staring point of the current study (which lasted for three years), because the research in literature and scientific information in online databases offer very few information on rabbit meat quality, especially on hares. The effectuated studies till now on rabbit meat are realised on hybrids of medium breeds (especially New Zealander and Californian) and are concentrated in Mediterranean countries (Spain, Italy, France). In our country are less papers on rabbit meat quality and I didn't found anything of Belgian Giant breed. On hares I've notice an ample study

regarding their morphological characteristics (corporal measurements) and elements of hunting fund management. Poor information (or nonexistent) in this domain (characterization of rabbit meat quality) was at the base of the research theme.

PhD thesis entitled "RESEARCH REGARDING CHARACTERIZATION OF MORPH-PHYSIOLOGICAL STATUS AT RABBIT AND HARE IN CORRELATION WITH SENSORIAL AND NUTRITIVE-BIOLOGICAL MEAT PROPERTIES", under the careful guidance of Mr. **PhD Professor Paul Corneliu BOIŞTEANU**, have two parts, divided in 11 chapters, to which were added general conclusions, recommendations and references and sum around 270 pages of which the first part (Study of literature) covers 74 pages and the second part (Own research) have 177 pages.

First part, study of literature, have a number of three chapters in which are synthetic presented the trophic-biological importance of rabbit meat in human nutrition (chapter I), general data regarding the base of morph-physiology of meat production, biology of the studied breeds (rabbit and hare), evaluation importance of indicators with metabolic profile (haematological profile and biochemical profile at rabbit), muscular tissue physiology at rabbits (organization of the somatic muscular tissue, metabolic and contractile specialization of muscles, elements of morphology, characterization of muscular fibres, biochemistry of muscular tissue at rabbit) (chapter II). In chapter III was realised a characterization of the nutritive-biological value of rabbit and hare meat (nutritional quality of rabbit meat, protein content and their quality, vitamins content, minerals content, lipids content, enlightening the role of fatty acids for human organism). In this chapter are also described the after-slaughter biochemical processes and characterization of sensorial properties of rabbit and hare meat.

Second part of the thesis, own research, have eight chapters summing 177 pages starting with experimental design and conducting research (chapter IV), followed by two chapters (chapter V and VI), which characterized the physiological status (biochemical and haematological determinations) and morphological one (cytological and histological determinations on striated muscles), for the both studied breeds. The next chapters present the obtained results regarding rabbit meat: the chemical composition, content in fatty acids, pH evolution, sensorial characterization through classical methods and sensorial characterization through instrumental methods (colour determination using CIELAB system and meat texture determination through Warner-Bratzler shear forces). Also are presented the obtained results regarding the collagen content and its influence on meat texture. Further were evaluated, by comparison, the losses by boiling of rabbit and hare meat.

To be able to realize the determinations, biological material was formed by 154 individuals: 79 hares (34 males and 45 females) and 75 rabbits (25 males and 50 females) belonging to Belgian

Giant breed.

Hares which were gathered (during hunting seasons 2009-2010, 2010-2011, 2011-2012), were from Iaşi County hunting funds (Coarnele Caprei, Ciurea, Cotu Morii). So were harvested different muscular groups (*Longissimus dorsi, Triceps Brachi, Biceps Femoris, Semimembranosus, Psoas, Cervicalis, Intercostalis* muscles) and the main internal eatable organs (cord, liver and kidney) to determine chemical composition and pH evolution.

Characterization of sanguine parameters was realised using a haematological automatic analyzer, ABX Micros VET ABC. For this purpose were determined: the number of red blood cells – erythrocytes (RBC); number of white blood cells – leukocytes (HGB); rate of red blood cells (haematocryte) (HCT); mean cell volume (MCV) – size of red blood cells; mean cell haemoglobin (MCH); mean cell haemoglobin concentration (MCHC); number of thrombocytes (PLT).

The highest value of leukocytes number (WBC) was observed at rabbit females, $6.35x10^3/mm^3$, and the lowest one at hare males ($4.65x10^3/mm^3$).

The highest values of erythrocytes (RBC) was observed at hare females ($11.25x10^6/mm^3$), followed by the ones for hare males ($10.24x10^6/mm^3$), and the lowest ones for rabbit females ($6.01x10^6/mm^3$) and then for rabbit males ($6.57x10^6/mm^3$).

The highest mean value for total haemoglobin quantity (HGB) was recorded at hare females 21.74 (g/dL), and the lowest one at rabbit females 12.65 (g/dL).

Rate of red blood cells (HCT) recorded the highest mean values for hare females 67.30%, followed by the hare males, with a value of 62.36%. Lowest mean rates of haematocryte were observed for rabbit females, 39.854% followed by rabbit males 45.866%.

As regarding the mean cell volume (MCV), could be observed a higher quantity at rabbits (males – 71.33 μm^3), followed by females (66.71 μm^3) and then the ones for hares, with quite close values (61.48 μm^3 for males and 60.29 μm^3 for females).

Mean for haemoglobin (MCH) recorded the lowest values for hare males (18.4 pg), followed by females (18.99 pg). At rabbits (Belgian Giant breed), for haemoglobin mean (MCH), were observed mean values quite close, with a light increasing for males (21.733 pg), followed by the ones for females (21.122 pg).

For haemoglobin mean concentration (MCHC), were observed the highest values for rabbit females (31.72 g/dL) followed by hare females (31.53 g/dL). The lowest mean values were recorded for hare males (29.96 g/dL) followed by the ones for rabbit males (31.1 g/dL).

For the number of thrombocytes (PLT), were recorded the highest values for hare females, $533.41x10^3/mm^3$, $379x10^3/mm^3$ for rabbit males, while rabbit females and hare males had mean values relatively close ($344.387x10^3/mm^3$ and $341.40x10^3/mm^3$).

Characterization of biochemical parameters was determined using a biochemical automatic analyzer ACCENT 200 and were determined the main indicators of metabolic profile: total proteins; albumin; uric acid; urea; cholesterol; triglycerides; glucose; amylase; aspartat-aminotransferase; alanin-aminotransferase; alanin fosfatase; calcium; magnesium; phosphorous.

Mean values of the determined biochemical parameters varied for rabbits and hares. After applying the statistical analysis were enlightened insignificant differences between sexes at the level of same breed, with the exception of enzymatic profile, where were observed significant differences for ASAT (aspartat-aminotransferase) between females and males, for hares.

Morph-structural characterization of the muscular samples harvested from rabbits and hares are shown in chapter VI. Here are presented the obtained results after histological determinations compared by breeds, on the lamella obtained through paraffin section method for muscles *Longissimus dorsi, Semimembranosus* and *Psoas.* At rabbits (Belgian Giant breed) we could observe a higher mean value of muscular fibres dimension (great diameters, small diameters, mean diameters, myocytes area and transversal section area) in comparison with the obtained results for hares. This fact was reflected also in the tough texture of rabbits' meat (proved by the high value of Warner-Bratzler shear forces).

Chapter VII presents in comparison by species and sex the obtained results after determination of **chemical composition** (content in proteins, lipids, water and ash) and also shows the caloricity, dry matter content and nitrogen free extract substances.

As regarding the protein content, the highest values were observed in *Psoas* muscles at hares, with a mean rate of 21.93% for females and 21.65% at males, than to rabbits, where, at males we had a mean of 21.22% and at females we recorded a mean of 21.28%. At muscles *Longissimus dorsi* protein content had higher mean values for males (21.7% for rabbits and 21.65% for hares), than to females (21.52% for hares and 21.23% for rabbits). The lowest mean values of protein content were recorded at rabbits, in *Intercostalis* muscles, 18.4% at males and 16.65% at females and were due the high content in lipids.

Statistical evaluation of the obtained results show insignificant differences of protein content, with the exception of *Triceps Brachii* muscle, for hares, at which were founded distinct significant differences between sexes. For rabbits, protein content recorded insignificant differences, with the exception of kidney where were observed significant differences between sexes.

For fat content, were observed higher values at rabbits in comparison with hares. Higher fat content was recorded at *Intercostalsis* muscles, with a higher mean value for rabbit females 18.1%, followed by males, with a mean value of 16.95%. The same phenomenon was observed for cervical muscles. The lowest fat content was recorded at *Psoas* muscles where the mean

value was 1.69% for rabbit males, followed by the one of 2.75% for rabbit females. Low values of fat content were also recorded at *Longissimus dorsi* muscles with a minimum value of 1.52% for hare females and 1.75% for hare males.

For fat content in the studied muscles, were recorded insignificant differences for rabbits. For hares, the test of variance analysis applied to lipids content, show insignificant differences between sexes, with the exception of *Triceps Brachii* muscle, where were founded significant distinct differences.

Regarding **water content** for rabbit meat, the highest mean values were recorded *Biceps Femoris* muscles for hare males (75.32%), and at rabbits were recorded the highest values for *Psoas* muscles (75.93%), harvested form males. The lowest mean values of water content were recorded in *Intercostalis* muscles (62.7%) and in *Cervicalis* ones (65.65%) harvested from rabbit females, these mean quantity being reverse proportional with the determined value for lipids.

Making a statistical evaluation of water content was observed insignificant differences at hares, with the exception of *Triceps Brachii* muscles, which were found distinct significant differences between sexes. For rabbits were founded insignificant differences between sexes.

Highest amount of **dry matter** was observed for *Intercostalis* muscles harvested from rabbits (Belgian Giant), females 37.3% and males 36.5%, followed by the muscles *Cervicalis* (34.4% for females and 32.5% for males). **Energy value** showed the highest level also for the *Intercostalis* (273.3 Kcal/kg) and *Cervicalis* muscles (239.1 kcal/kg) harvested from female rabbits. This is due to higher amount of fat that is usually found within these muscles.

Ash content for the main analysed muscular groups varied from the lowest mean values of 1.01% case of *Intercostalis* muscles harvested from rabbits to the highest mean values, 1.26%, for *Triceps brachii* muscles, originated from hares.

Content in fatty acids of the analysed meat presented quite similar values for the harvested muscular groups, the difference being in the high content of hare meat (*Lepus Europaeus* Pallas), in unsaturated fatty acids, in comparison with the one obtained for rabbits Belgian Giant breed.

The **pH evolution** of the meat harvested from rabbits (Belgian Giant breed) and from hare (*Lepus Europaeus* Pallas), had an fluctuant ascendant trend, quite similar for females and males, presenting insignificant differences both for rabbits and also for hares.

Appreciation of **sensorial properties** of meat through classical methods, obtained the highest mean scores for hares, and through instrumental determinations proved the superiority of this meat by a more increased tenderness and an more intense color.

As a result of application of the **Warner-Bratzler shear force** test on muscular groups (*Longissimus dorsi* and *Semimembranosus*) harvested from hares, were observed the highest

mean values of the maximum shear forces for muscles *Semimembranosus*, with a significant difference between females and males. The highest mean value of shear force was 4.318 kg/cm^2, for hare females. For hare males, the mean value of the maximum shear force for the same muscle was 3.293 kg/cm^2. The lowest mean values of maximum shear force were recorded at hare females for *Longissimus dorsi* muscle, with 2.006 kg/cm^2.

Determining **the colour parameters** (CIELAB system), at *Longissimus Dorsi* muscles harvested from Belgian Giant rabbits, for luminosity were obtained quite similar values for males (59.120) and females (58.320). Mean value of luminosity determine for rabbits is close enough to the one obtained for turkeys (data form the literature).

For hare meat after the realised determinations on *Longissimus dorsi* muscle, could be observed mean values quite close between sexes, meat luminosity having much more lower values in comparison with the meat harvested from rabbits, with a mean of 28.555 for females and a mean of 28.938 for males.

Evaluating the **losses through boiling** for rabbit meat was observed that the highest mean values were enlightened for rabbits at the level of *Semimembranosus* muscle, with rate of 36.45% for females and 35.95% for males and the lowest ones were recorded at *Longissimus dorsi* muscles. For hares the observed mean values for boiling losses were generally lower in comparison with the ones determined for rabbits.

Nutrition plays a crucial role in man's health state; must be scientific, rational and balanced, adapted to the demands of each individual. To establish an optimal food intake, must be taken into account sensorial properties of foods, nutritive and/or dietetic value and their hedonistic quality. Therefore we strongly recommend consumption of rabbit meat (rabbit and hare) through the evaluations presented in the current study.