Appendix no 2

Summary of professional accomplishment

PhD. Danuta Jaworska

Warsaw University of Life Sciences- SGGW
Faculty of Human Nutrition and Consumer Sciences
Department of Food Gastronomy and Food Hygiene

Warsaw, 2016

Content:

1. Personal data

1.1. Name and Surname (Maiden name)

Danuta Emilia Jaworska (Mucha)

1.2 Education and scientific degrees

2004-**Doctor of Philosophy degree in agricultural sciences,** discipline: food technology and nutrition; Faculty of Human Nutrition and Consumer Sciences, Warsaw University of Life Sciences (WULS)-SGGW, thesis entitled: Influence of texture attributes on the overall sensory quality and acceptance of selected food products.

1987- **Master of Science degree in agricultural sciences,** specialization: food technology and human nutrition, field: human nutrition and consumer sciences; Faculty of Human Nutrition and Consumer Sciences, Warsaw University of Life Sciences -SGGW, thesis entitled: The effect of gender of growing rats on the use of protein in diet.

1.3 Information on previous employment

since 2005 - **Adjunct,** Department of Technology of Gastronomy and Food Hygiene, Faculty of Human Nutrition and Consumer Sciences, Warsaw University of Life Sciences WULS-SGGW,

2001- 2004 PhD study, Faculty of Human Nutrition and Consumer Sciences, Warsaw University of Life Sciences -SGGW

1987–2005 - **Assistant,** Department of Functional Food, Environmental and Commodity, Faculty of Human Nutrition and Consumer Sciences, Warsaw University of Life Sciences -SGGW (8-year gap - parental leave)

2. Scientific achievement being the basis of the habilitation procedure

2.1 Title of the scientific achievement

The scientific achievement, in accordance with Article 16, Paragraph 2 of the Act of 14 March 2003 concerning the scientific degrees and titles (Journal of Laws No. 65, item 595, as amended), is the series of 7 publications entitled:

The importance of sensory analysis in assessing the quality of meat and meat products in reference to technological and analytical aspects

2.2 The list of publications which constitute scientific accomplishment: (numeration according to appendix no 3, point. I.B):

I.B1. **Jaworska D**., Przybylski W., 2014: The effect of selected factors on sensory quality of pork. Żywność, Nauka, Technologia, Jakość, 5, 21-35.
15 pts MSaHE; IF 0.000
My contribution to this paper covers design of the work concept and preparing the review of literature, collecting and analyzing the results of the study, discussing the results in comparison to available data, writing the manuscript and incorporating the reviewers' comments into the text.
My contribution to this work I estimate at 80%.

I.B2. **Jaworska D**., Czauderna M., Przybylski W., Rozbicka-Wieczorek A.J., 2016: Sensory quality and chemical composition of lambs meat fed diets enriched with fish and rapeseed oils, carnosic acid and seleno-compounds. Meat Science, Meat Science, 119, 185-192.
35 pts MSaHE; IF 2.615
My contribution to this paper covers design of the work concept and preparing the review of literature, designing sensory evaluations, collecting and analyzing the results of the study, discussing the results in

comparison to available data, participation in the manuscript writing, incorporating the reviewers' comments into the text.
My contribution to this work I estimate at 60%.

I.B3. Przybylski W., **Jaworska D.,** Czarniecka-Skubina E., Kajak-Siemaszko K., 2008: Ocena możliwości wyodrębniania mięsa kulinarnego o wysokiej jakości z uwzględnieniem mięsności tuczników, pomiaru barwy i pH z zastosowaniem analizy skupień. Żywność, Nauka, Technologia, Jakość, 4, 43-51.
4 pts MSaHE
My contribution to this paper covers co-authoring the paper concept, preparing the review of literature, carrying out the technological experiment, participation in analyzing the results of the study, writing the manuscript, incorporating the reviewers' comments into the text.
My contribution to this work I estimate at 34%.

I.B4. **Jaworska D**., Przybylski W., Kajak-Siemaszko K., Czarniecka-Skubina E., 2009: Sensory quality of culinary pork meat in relation to slaughter and technological value. Food Science and Technology Research, 15, 1, 65-74.
10 pts MSaHE; IF=0.401
My contribution to this work covers designing of the paper concept, preparing the review of literature, carrying out the experiment, preparing results for statistical analysis, participation in analyzing the results of the study, writing the manuscript, incorporating the reviewers' comments into the text.
My contribution to this work I estimate at 70%.

I.B5. **Jaworska D**., Neffe K., Kołożyn-Krajewska D., Dolatowski Z., 2011: Survival during storage and sensory effect of potential probiotic lactic acid bacteria *Lactobacillus acidophilus Bauer and Lactobacillus casei Bif3` IV* in dry fermented pork loins. International Journal of Food Science and Technology, 46, 12, 2491-2497.
25 pts MSaHE; IF 1.259
My contribution to this work covers participation in designing the work concept, preparing the review of literature, preparing and carrying out the sensory experiment, collecting and analyzing the results of the study, participation in writing the manuscript, participation in incorporating the reviewers comments into the work.
My contribution to this work I estimate at 40%.

I.B6. Neffe-Skocińska K., **Jaworska D**., Kołożyn-Krajewska D., Dolatowski Z., Jachacz-Jówko L., 2015. The effect of LAB as probiotic starter culture and green tea extract addition on dry fermented pork loins quality. Journal of Biomedicine and Biotechnology (changed for BioMed Research International), Article ID 452757, doi:10.1155/2015/452757.
20 pts MSaHE; IF 1.579
My contribution to this work covers participation in designing the work concept, preparing the review of literature, preparing and carrying out the sensory experiment, collecting and analyzing the results of the study, participation in writing the manuscript, participation in incorporating the reviewers comments into the work.
My contribution to this work I estimate at 40%.

I.B7. Strydom P. E., **Jaworska D**., Kołożyn-Krajewska D., 2016: Meat Quality of Slaughter Animals in: Meat Quality. Meat Quality. Genetic and Enviromental Factors. (red.) Przybylski W., Hopkins D, CRC Press, pp 32-80,
5 pts MSaHE
My contribution to this work covers writing a part of the book chapter based on my own sensory experience in the field of meat quality evaluation, the relevant literature selection and incorporating the reviewers comments into the work.
My contribution to this work I estimate at 40%.

2.3. Discussion of the scientific work and the achieved results together with a discussion of their possible application

Introduction

Sensory evaluation of food is a kind of interaction between man and the environment, where the measuring apparatus used to test it is the central nervous system and the human senses. Sensory response relies on the detection, recognition, differentiation and scaling of the stimulus. Sensory analysis is defined as the measurement and evaluation of properties (quality characteristics; attributes) of the product with one or more of the senses, which are used as the measuring apparatus. Appropriate conditions of the assessment, requirements concerning the people conducting it as well as suitable methods must be guaranteed. Because of the information about the impressions which each stimulus causes in the human body, sensory evaluation of food is an irreplaceable tool used to the quality control of the food. The importance of sensory analysis is based on the fact that it provides answers to the questions such as relating to quality attributes, their combinations or the proportions have an influence on certain reactions of consumers to the tested products. The uniqueness of the information provided by sensory analysis makes it an indispensable instrument to evaluate the potential success of specific food products on the food market.

Food market is characterised by its quantitive and qualitative supply and a high competition, therefore one can observe typical behavior patterns of food producers, aimed at attracting new and retaining existing customers. These strategies are implemented through a variety of treatments involving the special care of the delivery of consistently high quality of existing products as well as introducing novelties to the market.

The ultimate verifier of these changes in the twenty-first century is the consumer who, being offered a very rich product portfolio chooses and decides on buying a particular product. Sensory analysis has a unique significance for all subjects related to the food marketing and the whole food chain.

Meat production of high quality that meets the expectations of consumers and processors is a very important issue, especially in the situation of a large supply of meat. In Poland and in many European countries pork is the dominant species of meat. It is known that a number of intravital and *post-mortem* factors determine the quality of the raw material; both the technological as well as the culinary one.

For breeders high quality is identified mainly with the outstanding features of the slaughter pigs, as they determine the profitability of their farms. While meat for processing should be characterized by sufficient value to the technology process, culinary meat must have a certain level of attractiveness of the sensory characteristics in order to gain acceptance by the consumer who is looking for high quality products.

Due to the health issues consumers most often look for the lean meat which is most preferably, almost free from fat and with a light red color. Thus, the greater acceptability of meat is obtained for small or medium intramuscular fat content (low or medium marbling). Furthermore, in order to prevent the development of many human diseases and improve the nutritional value of meat enrichment of the desired ingredients such as polyunsaturated fatty acids is often used in animal feed.

By an increase in the share of polyunsaturated fatty acids n-3 PUFA in the diet of animals an adequate protection of the meat against oxidative processes is required. It can be achieved by the use of antioxidants. However, a diet supplementation can significantly modify the sensory characteristics of the meat, and even cause the lack of its acceptance by consumers. These problems can be solved by using sensory analysis provided that proper preparation, experience and knowledge of the people who are members of sensory panel teams are guaranteed.

Food enriched with various additives is the segment of functional food marked. Functional food is gaining recognition among consumers provided that the product is sensory acceptable by the consumers. Studies have shown that probiotic bacteria may be added to the fermented meat products. However, the product during storage can undergo adverse changes in sensory and physico-chemical characteristic. Oxidation of lipids in meat products can be controlled by using natural or synthetic antioxidants, such as plant extracts, due to their strong antioxidant properties.

Knowledge of criteria concerning meat quality, which determine its purchase by consumers is essential for producers and traders, who also need to meet the expectations of consumers. Experimental determination of these criteria poses a number of difficulties due to the variability of individual batches of meat, as well as the relatively short time of storage in which fresh meat retains high quality as for all sensory characteristics.

Even a product with high nutritional values well-known to consumers will not be accepted if it does not have adequate sensory quality, which is attractive appearance, aroma, freshness and flavour. There is a strong need to examine the national pork, as it has a unique quality resulting from genetic, environmental and technological determination.

2.3.1. The objective, hypotheses, some elements of research methodology

The aim of the presented scientific achievement was to determine the significance of sensory analysis in the quality of meat and meat products assessed in reference to technological and analytical aspects. Furthermore, the objective was to identify the optimal methods of sensory evaluation, taking into account the conditions of research and the appropriate level of training of assessors necessary to obtain reliable results in the evaluation of meat and meat products. On the basis of the above the following hypotheses were formulated:

A. Sensory quality of culinary meat depends on the breed, genotype, meatiness and diet of animals.

B. Sensory quality of meat after heat treatment is determined by the technological characteristics of the meat and the slaughter value of animals. The high sensory quality of culinary meat (raw) guarantees the high quality of the meat after thermal processes.

C. The use of additives such as probiotics and green tea extracts at the stage of meat processing determines the quality of finished products and the storage ability.

D. The use of appropriate sensory methods and proper procedures in the preparation of samples for evaluation, guarantees repeatable and valuable results with significant explanatory values in the evaluation of meat and meat products.

In order to clarify the indicated hypotheses sensory research was implemented with the participation of sensory panel trained in the field of sensory evaluations. Conducting the research was preceded by the special training organized by me. The participants were trained to competently apply profiling method of quality (Quantitative Descriptive Analysis- QDA) in accordance with the requirements of ISO 13299: 2003. Hence, in 2005 I started working, according to the standard ISO 8586-2: 1996, on improving the qualifications of the panelists forming the evaluation team through the appropriate theoretical and practical preparation, which I mastered due to the long cooperation with prof. dr. Nina Baryłko-Pikielna. The experience I gained also during the internship in the laboratory of sensory analysis at the University of Bonn.

As a result of training, individual panelists gained significant experience in sensory assessment of meat and meat products. The panel works under my direction, and I am a leader of it. As far laboratory evaluations are concerned, I am proud of fourteen-year experience. I published many articles concerning the studies on the impact of various factors on the quality of food products including meat and meat products, of which 6 of them are

presented to this achievement. As for the work, which concerned other aspects of research, my role was to plan and carry out sensory experiences, study results, their discussion.
Furthermore, to his achievement I included the chapter in the English-language monograph, where I presented the state of knowledge and the proposed criteria for assessing the quality of meat, determined on the basis of my own experience and literature data on methodological aspects of meat quality research.

2.3.1.A. Conditions of sensory quality of culinary meat, depending on the selected genetic factors (breed, genotype, meatiness, intramuscular fat), *post-mortem* trait (pH) and environmental factors (nutrition)

Publications:

I.B1. Jaworska D., Przybylski W., 2014: The effect of selected factors on sensory quality of pork. Żywność – Nauka, Technologia, Jakość, 96, 21-35.

I.B2. Jaworska D., Czauderna M., Przybylski W., Rozbicka-Wieczorek A.J., 2016: Sensory quality and chemical composition of lambs meat feed diets enriched with fish and rapeseed oils, carnosic acid and seleno-compounds. Meat Science, 119, 185-192.

The first hypothesis was on research related to the sensory quality of raw meat from selected intravital factors, such as breed, genotype, weight, conformation and animal nutrition (*pub. I.B1 and I.B2).*

Sensory quality of pork originating from different breeds

The studies were carried out on the fatteners Neckar line as an example of typically meat line, used for the production of fatteners with high growth rates and favorable characteristics for slaughter value, such as large 'eye' of loin and a big ham. This line has been bred to replace the race Pietrain, characterized by a lower growth rate. In the present study it was compared to the meat from line Neckar and meat obtained from P76 line (high meatiness line).

Meat quality is dependent on the specific breed due to the different ratio of meat to fat. The quality is dependent also on the muscles, which eventually affect the sensory characteristics, especially the tenderness and juiciness of the meat. Breed selection and the diameter of muscle fibers and the amount of intramuscular fat or water binding capacity is also related to the perceived palatability of the meat. Proper breed selection is an extremely important aspect of the economy market from an economic point of view. Selection is based on obtaining the correct proportions of meat and fat in carcasses, according to market requirements.

Our study, regarding comparing the sensory quality of meat from pigs Neckar and lines P76 showed higher quality of meat from the line Neckar. The meat was characterized by a much higher tenderness and juiciness and higher intensity of the positive flavour notes. This result can be explained by much higher levels of marbling in meat of Neckar in relation to the meat of the line P76 (*pub. I.B1).*

The results have very important applications for the Polish breeders as they indicate breeds useful for crossing in order to produce hybrids with high sensory quality of meat. It should be noted that in our country many studies have been conducted on the proteolysis of proteins or the suitability of the meat for the lines Neckar, but there is lack of research on the sensory quality of the meat from these fatteners. This research fills a gap in this area and can provide valuable information for farmers and meat processors.

Sensory quality of pork, depending on the animal genotype

The results of the study on the pork quality, depending on the gene calpastatin (CAST/RsaI) are presented in the work I.B1. They indicated that the gene calpastatin (CAST/RsaI) had an impact on the sensory quality of the meat after heat treatment. The

studies showed that pork obtained from polymorphic variants of genes CAST: CC, CD and DD differ significantly as for tenderness. Most studies suggest that calpain is among the main enzymes involved in the terderness process of the meat. It is believed that calpain participates in the degradation of cytoskeletal proteins, such as titin, desmin and nebulin. The rate of degradation and calpastatin inactivation is related to the rate of proteolysis and tenderisation observed in meat. This fact has a direct impact on the quality of the meat. However, the exact factors that regulate calpastatin degradation by calpain is not fully understood. This fact justifies conducting this type of research, since it is aimed at improving the quality of the raw material through genetic optimization of animal husbandry.

The studies on sensory quality of defective meat are presented in the work I.B1. They indicated that its occurrence depends on genetic and environmental factors. In the present study sensory evaluation of faulty meat samples (different types) was conducted. Acidic meat (ASE - acid, soft, exudative) after heat treatment was characterized by the lowest level of juiciness and flavour. Meat of RSE type (reddish, soft, exudative) did not change in colour as much as ASE meat or PSE type meat (pale, soft, exudative).

Faulty meat type ASE is associated with the RN gene and has an impact on the low juiciness and flavour of meat. While meat DFD (dark, firm, dry) occurs rarely, its appearance always disqualifies the usefulness of such meat for culinary purposes. Meat DFD also has a very high susceptibility to microbiological changes; which is associated with a high value of pH_{48} and the faster increase in growth of bacteria. The study (*I.B1*) showed that although the meat DFD was characterized by the lowest quality with respect to raw meat and after heat treatment was tender and juicy.

However, meat with PSE defect was not tender and juicy after the heat treatment. The meat of ASE type was characterized by low intensity meat flavour, low tenderness and juiciness. Other studies also confirm the low quality of this type of meat (Żelechowska et al., 2012). Muscle proteins profile indicated significantly higher content of calpain in PSE and acid meat compared to meat regarded as the normal one.

I find the innovative statement that although the meat with DFD defect is characterized by unattractive appearance and their durability is limited, there is the possibility of its use for the purpose of processing and consumption.

Sensory quality of the meat, depending on the meatiness of animals. In accordance with the requirements of the market in recent years (2005 - 2015), the average carcass leanness has increased from 52.5 to 57.0%. The breeding focuses on meatiness growth and reducing body fat, resulting in many cases, excessive reduction in the amount of intramuscular fat (IMF- intramuscular fat). In the study (I.B1) it was found that meat from carcasses classified as class S (according to EUROP classification) was characterized by a lower level of the IMF in relation to meat from class U. Meat from carcasses classified in class S was characterized by a significantly higher drip loss in comparison to meat qualified as class E.

Additionally, there was a significantly higher frequency of defects as PSE meat and partly PSE meat in carcasses qualified for the S class. The rate of increase in body weight has a direct impact on reducing the period of fattening of pigs. Muscle growth is dependent on the rate of deposition of protein and fat, which is defined by genotype and environmental factors. Increasing of the mass slaughter of pigs results in a more intense meat colour, higher intramuscular fat content and lower drip losses. The meat of the class U was characterized by the expected lower quality compared to meat of class S (although the difference was not statistically significant). However, the quality of the meat class U after heat treatment was characterized by a much higher experienced quality, which was associated with higher tenderness and juiciness.

The value of culinary meat depends largely on the amount of intramuscular fat, which is responsible for the sensory quality evaluation, especially for tenderness, juiciness and flavour of the meat. Compared to available literature, not in all cases a significant difference in the sensory quality of meat from different classes of meatiness was showed. This is due to the sensitivity of tools used in sensory test.
These results have application character as it is possible to make recommendations for the meat industry regarding the methods for the meat selection for culinary purposes -class E and meat for the processing purpose (high technological value) - class S and U.

The relation of the sensory meat quality to the intramuscular fat content.

Currently improving pork quality is focused on increasing the level of IMF in the muscles and is one of the main goals for farmers in the European countries as increasing leanness of the meat resulted in reducing its sensory quality. The amount of visible fat is the strongest stimulus of visual assessment of the meat by the consumer and affects the decision to purchase it or not. IMF level depends on the breed, meatiness, final carcass weight, and also on feeding during the period of growth (Rosenvold and Andersen, 2003).
The relationship between the IMF and the pork tenderness is inconclusive - some researchers confirmed a positive relationship (Fernandez et al., 1999; Fortin et al. 2005), while others have not confirmed this association (Gorasson et al. 1992).

In my own study a positive effect of IMF on juiciness, tenderness and flavor of meat is reported (I.B1). The results of this study indicate that the level of IMF had a significant impact on the sensory acceptance of the fresh meat and its quality after heat treatment. The degree of acceptance of raw pork was significantly higher if the level of IMF was less than 2.0% and tenderness, juiciness, flavour and overall quality of the meat after heat treatment was higher in case when IMF content was above 2.0%. According to many studies (Channon et al. 2004; De Vries et al. 2000) the minimum value of IMF should be from 2.5% to 3.0%, higher values are associated with the risk of rejection of pork by consumers.

The original aspects of my own study was to establish a minimum level of the IMF of 2% (in Polish conditions), considered necessary to ensure proper and positive sensory experience during the consumption after heat treatment process.

Sensory quality of the meat, depending on the feed supplementation

In order to obtain high-quality culinary meat it is possible to implement the appropriate strategy of feed supplementation. This method seems to be more beneficial and simpler in comparison to the genetic modification of animals, which consumers do not accept. Appropriate animal nutrition may affect the meat quality by optimizing the internal and external characteristics of muscles. Dietary compounds such as proteins, fatty acids, vitamins and minerals may affect the added value of meat and consequently its quality. Studies on the role of dietary factors in the development of human diseases focused on the possibility of increasing the share of fatty acids of n-3; polyunsaturated (PUFA) in meat, which reduces the negative ratio of n-6 PUFA to n-3 PUFA (n-6 / n-3) that in the human nutrition should be 4: 1. Therefore, diet can influence the accumulation of PUFAs, in particular conjugated linoleic acid isomers (CLA) and their precursors in the muscles. It is further noted in the tissues of animals and positive correlations of Se concentrations and unsaturated fatty acids are observed. Considering all of the above facts it was hypothesized that the fish oil (FO), carnosic acid (CA), and selenium (Se) which is added to the diet may affect the sensory quality and increase the concentration of unsaturated fatty acids in meat. The original advantage of the study was to investigate the effect of different chemical forms of Se added to the diet, and CA and FO on the sensory quality and chemical composition of lamb meat (I.B2).

In cooperation with the The Kielanowski Institute of Animal Physiology and Nutrition in Jablonna I conducted joint research whose results indicate that the addition of fish oil at a level of 1% or animal feed including fish oil, carnosic acid (0.1%), and selenium in inorganic form (0.35 ppm) causes a significant decrease in sensory quality of lamb meat in comparison to meat from animals fed a control diet. In addition, the enrichment of feed with selenium most effectively reduced the sum of the concentration of fatty acids, especially atherogenic (ASFA) and the thrombogenic (TFSA), in *longissimus thoracis* muscle (I.B2).

To sum up, using the sensory methods makes it possible to verify the appropriate levels of bioactive ingredients in feed supplementation. It should be noted that the sensory quality of raw meat depended on environmental and intravital factors such as breed, genotype, body weight, meatiness and animal nutrition.

Summarizing, it has been proved that meat from the line Neckar has a higher quality compared to meat obtained from P76 fatteners, which was characterized by much higher tenderness and juiciness and higher intensity of the positive flavour attributes. Own study demonstrated that pork obtained from calpastatin gene polymorphisms: CC, CD and DD was significantly different in tenderness. The highest sensory quality of meat was found for DD genotype.

It has been found that the meat from U class was characterized by the lower expected quality of the raw meat as compared to class S (although the difference was not statistically significant). However, the meat quality of class U after heat-treatement (experienced quality) was characterized by a much higher tenderness and higher juiciness. In own study a positive effect of IMF on juiciness, tenderness and pork flavour was reported.

Furthermore, these results indicate that the addition of fish oil at a level of 1% or animal feed including fish oil, carnosic acid (0.1%), and selenium in inorganic form (0.35 ppm) resulted in a significant reduction of sensory lamb quality compared to meat of animals fed with control diet or a diet with fish oil, carnosic acid and organic form of selenium.

2.3.1.B. Sensory quality of culinary meat (raw meat) and meat quality after heat treatment

Publications:

I.B3. Przybylski W., Jaworska D., Czarniecka-Skubina E., Kajak-Siemaszko K., 2008: Ocena możliwości wyodrębniania mięsa kulinarnego o wysokiej jakości z uwzględnieniem mięsności tuczników, pomiaru barwy i pH z zastosowaniem analizy skupień. Żywność, Nauka, Technologia, Jakość, 4 (59), 43-51.

I.B4. Jaworska D., Przybylski W., Kajak-Siemaszko K., Czarniecka-Skubina E., 2009: Sensory quality of culinary pork meat in relation to slaughter and technological value. Food Science and Technology Research, 15, 1, 65-74.

The second research hypothesis concerned the assumption that the sensory quality of the meat after heat treatment is related to the slaughter value and the technology value. Additionally, the high sensory quality of raw meat provides high quality meat after thermal processes.

Motivated by health reasons, consumer most often prefer lean meat, almost completely devoided of fat. Similar observation are established in other countries in Europe (Ngapo et al, 2003). Greater acceptability is observed for meat obtained from low or medium intramuscular fat content (low or medium marbling). However, after heat treatment during consumption of meat the highest importance has the experienced quality. Consumers relatively higher assessed the meat with higher fat content. Thus it demonstrated that the expected quality of meat does not always correspond to the experienced quality.

With a large supply of pork, it is important to produce pork that meets the demands of consumers. Publication I.B3 concerns the evaluation of the possibility of extracting culinary meat quality with regard to the parameters of high slaughter value and high technological value of meat. Analysis of the results was carried out by using advanced statistical methods,

including cluster analysis. The obtained relationship between the value of meat content expressed as meatiness and technological parameters of the meat (ultimate pH, meat color parameters: brightness and intensity of L* a*) and the culinary meat quality (sensory quality, natural drip loss and efficiency in cooking).

It should be noted that the relationship of pH measured after 48 h after slaughter is stronger compared with the measurement of pH_{24} *post mortem*. This fact points to the longer duration of the changes taking place in the muscle tissue after slaughter, which are significant for the culinary meat quality, as well as little value of this measurement pH_{24} for the meat quality *post mortem* diagnosis. Analysis of the total and simultaneous interaction of characteristics of the technological quality of meat on culinary meat quality was made possible through the use of canonical analysis, which allows the estimation of the relationship between sets of attributes. It has been shown that the characteristics of culinary quality were highly associated ($r = 0.83^{**}$ $p<0.01$) and determined (about 70%) by the meatiness of the carcass and the colour values (L^*_{48} and a^*_{48}) and ultimate pH_{48} of meat.

The obtained results indicate the possibility of using the meatiness evaluation of carcasses carried out in meat plant and colour parameters (L*, a*) and the measurement of pH_{48}, to extract (in terms of production) culinary meat which could be characterized by very good quality with regard to sensory characteristics such as: tenderness, juiciness and flavour as well as low drip loss and adequate efficiency in heat treatment.

Analysis of distribution of tested elements in each group showed that the sensory quality of culinary meat contained within the following ranges: pH_{24} and pH_{48} between the values 5.50 and 5.80, meat in the carcass should be in the range of 55-58%. while the lightness parameter (L *) should be in the range of 52-55 while the intensity of the red color (a* parameter) should assume values of 8-14.

These factors have a practical use for the selection of meat for culinary purposes. The possibility of sensory evaluation of the quality of portioned raw meat packed in trays is based on the visual appearance qualities such as colour, fat cover, intramuscular fat and drip loss. It is not known to what extent each of these characteristics determines the appearance of the consumer preferences in the selection of portioned meat at the time of purchase. This choice should be of prognostic importance for the sensory quality of meat after heat treatment process.

The question arises to what extent the relevant criteria for the pork selection when purchased are reflected in the quality of sensory evaluated after thermal treatment and the perceived consumer satisfaction. In the available literature, there is no comprehensive data on this important issue. To determine a correlation between the expected quality during meat purchase and experienced meat quality the research work I.B.4 was conducted.

In order to conduct the study the raw meat samples were prepared. They looked like the pieces of meat exposed in supermarkets, on polystyrene trays. The consumer (n = 57) evaluated the intensity of colour of meat samples, uniformity of meat colour, marbling and overall acceptance. Then the meat samples were heated and the quality was re-evaluated. It was shown that the raw meat characterized by high visual quality (expected value) was characterized by low quality after heat treatment (experienced quality).

The calculated coefficient of linear correlation for the discussed relationship was r = -0.23. The quality of the meat after heat treatment has the highest influence on the palatability of meat (r = 0.88) and texture attributes: tenderness (r = 0.79) and the juiciness (r = 0.70). With regard to the validity of the texture attributes it should be noted that they are the most important ones out of all quality characteristics, but only when the meat has a suitable palatability (low intensity or negative flavours notes). My conducted research has shown that the characteristics of flavour were linked to the overall sensory quality of meat to a higher degree (critical validity) compared to the textural features.

I conclude that in terms of sensory quality of culinary pork while buying special attention is paid to the appearance of meat, the amount of fat and the presence of visible drip loss (criteria of "perceived quality"). In addition, it has been concluded that the measured parameters of technological quality (pH, drip loss, efficiency in cooking, efficiency in the curing and cooking) had a significant relationship with assessed distinguishing features of sensory quality. The calculated canonical correlation coefficient between the studied groups of features was CR = 0.63.

Lower, but also statistically significant relationship was between characteristics of the slaughter value (carcass weight, meat content, loin 'eye' thickness) and sensory quality of the meat (tenderness, juiciness, palatability) - CR = 0.52. The obtained results indicate that there is a possibility of pig selection for high quality pork production with the appropriate slaughter value, the technological quality as well as high sensory quality of meat delivered to sale points.

Summing up the results of research on identifying acceptable culinary meat traits, it was found that the use of cluster analysis allowed the meat separation of varying quality, including meat characterized by the features of positive values in term of culinary meat quality. It was demonstrated that the raw meat which is characterized by high visual quality (expected value) is characterized by low quality after heat treatment (experienced quality). The calculated correlation coefficient for the discussed relationship was r = -0.23.The results also indicate that there is a possibility of pork production with the high slaughter value, the appropriate technological quality and high sensory quality of meat. These results can be used in the national system of food quality on the pork production labeled with the appropriate quality.

2.3.1.C. The use of selected functional additives for meat product

Publications:

I.B5. Jaworska D., Neffe K., Kołożyn-Krajewska D., Dolatowski Z., 2011: Survival during storage and sensory effect of potential probiotic lactic acid bacteria Lactobacillus acidophilus Bauer andLactobacillus casei Bif3 IV in dry fermented pork loins. International Journal of Food Science and Technology, 46, 12, 2491-2497.

I.B6. Neffe-Skocińska K., Jaworska D., Kołożyn-Krajewska D., Dolatowski Z., Jachacz-Jówko L. 2015: The effect of LAB as probiotic starter culture and green tea extract addition on dry fermented pork loins quality. Journal of Biomedicine and Biotechnology (changed for BioMed Research International), Article ID 452757, doi:10.1155/2015/452757.

The third hypothesis assumed that the use of additives such as probiotics or green tea extracts during meat processing determines the quality of finished products and their storage ability. In order to verify this hypothesis I used methods of sensory analysis.

Sensory quality of the product with potentially probiotic bacteria addition.

Lactic acid bacteria have been used for a long time as starter cultures in the dry fermented meat products, especially in conventional sausages production. Klingberg et al. (2005) and Arihara (2006) have shown that probiotic bacteria may be added to the fermentation of dry meat products. A new and interesting idea involves inoculation probiotic strains in meat products. Meat products with probiotics have a huge potential in the future, as consumers increasingly pay attention to functional and healthy meat products. However, the commercial use of probiotic microorganisms in fermented meat products is still marginal.

Therefore the aim of the work (I.B5) was to determine the sensory quality of the product, depending on the use of two probiotic strains of *Lactobacillus acidophilus* and *Lactobacillus casei Bauer Bif3 '/IV* for the production of ripened raw loins. The results showed that the strains tested in this study had no significant effect on the overall sensory quality of products after fermentation and maturation time. Higher sensory quality of products after 180 days of

storage was observed in case of the samples fermented with bacteria Lactobacciluss Acidophilus Bauer with 0.2% glucose in comparison to Lactobacillus casei Bif3 '/IV. However, the 180-day storage time strongly affects the sensory quality of the product decreasing the quality in relation to the sensory quality of the samples after fermentation time.

Therefore, further studies should be conducted with the use of other strains of probiotic bacteria in order to obtain a more satisfactory result of sensory quality of products after storage.

Sensory quality of the product with potentially probiotic bacteria and green tea extracts

The probiotic starter cultures play an important role in the process of fermentation, maturation and meat products storage, increasing their health-promoting properties. On the other hand, it can accelerate the oxidation of lipids, reducing the time of their storage. Therefore, oxidation of lipids in meat products can be controlled using natural or synthetic antioxidants. In recent years, special attention was paid to the functional properties of plant extracts due to their strong antioxidant properties. Tea catechins are the main group of polyphenolic flavonoids in green tea. The antioxidant properties of tea catechins were studied in various products including beef, pork and poultry. Zhang et al. (2010) found that tea catechins were more effective in reducing lipid oxidation than α-tocopherol or BHA.

The aim of the work (I.B6) was to evaluate the growth of bacteria *Lactobacillus rhamnosus* LOCK 900 survival in fermented pork loins produced with the addition of green tea extract. Sensory quality of products was established in relation to the selected physico-chemical properties after 21 days of ripening and after 180 days of vacuum storage. It was shown that the addition of green tea extract had no impact on the quality of fermented products compared to the samples with *Lactobacillus rhamnosus LOCK 900* addition and 180-day storage. The applied storage time had a significant impact on lowering the sensory quality of the tested products. Adding green tea extract also had no impact on the sensory quality of the stored products. Storage time (180 days) resulted in a significant decrease in the sensory quality of the tested samples compared to the sensory quality after ripening period. The obtained results indicate that there is the need for research in this area by using other natural antioxidants in order to obtain a more satisfactory result of sensory quality.

Summarizing this stage of the study it can be concluded that the use of additives, such as probiotic bacteria and green tea extracts at the phase of processing significantly determined the sensory quality of the finished products:

- Sensory quality products derived from the use of probiotic *Lactobacillus acidophilus* and *Lactobacillus casei* Bauer Bif3 '/ IV was significantly decreased after 180 days of storage.
- The use of a bacteria strain *Lactobacillus rhamnosus* LOCK 900 and the addition of green tea extract had no effect on the sensory quality of the ripened products and the storage time (180 days) significantly affected the decreasing sensory quality of ripened loins. Thus there is a need for further research in the selection of appropriate strains of probiotic bacteria, or natural antioxidants to obtained high sensory quality of products.

2.3.1.D. Methodological aspects of conducting sensory analysis

Publication:

I.B7. Strydom P. E., Jaworska D., Kołożyn-Krajewska D. 2016: Meat Quality of Slaughter Animals in: Meat Quality (red) Przybylski W., Hopkins D, CRC Press, pp 32-80.

The fourth hypothesis concerns the importance of appropriate sensory methods, appropriate processes, sample preparation, proper training of evaluators, selection of appropriate methods and tools to obtain reproducible valuable results, allowing to explain the problems in the science of sensory evaluation of meat and meat products.

Many years of experience are the basis for the development of reference I.B7 and other publications, such as I.B1-I.B6 and II.A1-II.A6, II.A11-II.A13, II.D1-II.D5. An overview of

the current literature suggests that there are significant differences in the experiments results and the interpretation of the influence of various factors on the meat quality also differs. In many cases, panels come to conflicting conclusions. The differences in the results may have their source in the methodology of research. Among others, the source of the different results may be due to the way of carrying out sensory research. The authors use different types of sensory panels (trained, partially trained or completely untrained (consumers) to test meat.

Different methods are used for heat-treatment (cooking, frying, roasting, grilling), there are various heat treatment conditions (heating temperature of samples, process time, end temperature), there are also differences in sample preparation, in the size of the individual sample for evaluation, as well as the use of different meat muscles. These variations cause the situation that panels obtain results which are often difficult to compare. Therefore, standardization in the quality meat evaluation is important and necessary. It is recommended to use a uniform approach for conducting sensory evaluations. Using trained panels to sensory evaluation, their appropriate practical experience and a good knowledge of the methodology and sensory experience in the evaluation of meat and meat products are necessary to obtain reliable results.

Samples should be representative. Members of panels should be adequately trained theoretically and practically as for the methods used in the experiment, in particular, to a quantitative descriptive analysis. Panelists should be numerous enough, so that the average score in the evaluation of laboratory type should be based on the results of at least 18 units, and in the assessment of a hedonic for a minimum of 80 individual assessments. In addition, the analysis should be conducted under appropriate conditions, with a maximum noise reduction and rooms should be odorless, with proper air exchange. Own experience and also the literature on this issue is presented in the work I.B7.

2.4. Summary of a series of the publications

Conducted research on the sensory quality of pork, depending on the selected intravital and environmental factors, such as breed, genotype, weight, meatiness and animal nutrition, presented in publications reflects the achievements and supports the conclusion that these factors have a significant impact on sensory quality of raw meat.

Higher meat quality of Neckar line has been shown, which was characterized by much higher tenderness and juiciness and higher intensity of positive meat flavour attributes in comparison to meat obtained from P76 line. It was also found that the pork obtained from calpastatin gene polymorphisms was significantly different as for tenderness and DD variant characterized by the highest sensory quality.

The quality of the meat class U after heat treatment was characterized by a much higher quality which was a result of significant higher tenderness and higher juiciness. In this study a positive IMF effect on juiciness, tenderness and pork flavour is reported. Referring to the dietary supplementation the obtained results indicate that the addition of fish oil at a level of 1% or animal feed including fish oil, carnosic acid (0.1%), and selenium in inorganic form (0.35 ppm) resulted in a significant reduction in sensory quality of the lamb meat compared to the meat of animals fed a control diet.

Summing up the results of the research on identifying acceptable culinary meat traits it was found that there is a possibility of pork production with the high slaughter value, the appropriate technological quality and high sensory quality of meat.

To summarize research on processed pork, it can be stated that the use of additives such as probiotics and tested extracts of green tea at the stage of meat processing significantly determined the sensory quality of finished products. The used storage time (180 days) significantly affected the reduction in sensory quality of the products obtained with the use of probiotic strains, such as *Lactobacillus acidophilus* and *Lactobacillus casei Bauer Bif3 '/IV*.

In addition, the use of a strain of Lactobacillus rhamnosus LOCK 900 and the addition of green tea extract had no effect on the sensory quality of the products and used storage time (180 days) strongly influenced and decreased sensory quality of pork loins.

2.5. Conclusions

1. Sensory quality of pork after heat treatment statistically depends on a set of factors such as the breed of animal, genotype, meatiness, the content of IMF and animal feed supplementation.
2. The results indicate that there is a possibility of pork production with high slaughter value, the appropriate technological quality and high sensory quality of culinary meat. It was also shown that the raw meat which is characterized by high visual quality (expected quality) is characterized by low quality after heat treatment (experienced quality).
3. Sensory quality of meat products obtained by using probiotic *Lactobacillus acidophilus* and *Lactobacillus casei* Bauer Bif3 '/ IV was significantly reduced after 180 days of storage. Moreover, the use of a strain of *Lactobacillus rhamnosus* LOCK 900 and the addition of green tea extract had no effect on the sensory quality of the products and strongly influenced sensory quality of pork loins (strong decreasing). The use of tested strains of probiotic bacteria and green tea extracts had no significant effect on the quality of fermented products compared to the control samples. The using of the 180-day storage time was too long to maintain high product quality due to the sensory criteria.
4. Using trained panels to sensory evaluation, their appropriate practical experience in the meat assessment, appropriate sensory methodology in the meat and meat products evaluation is necessary to obtain reliable test results. Moreover, the method of preparation of tested material; applied heat treatment and its parameters, the representativeness of the sample units determine gaining valuable research results.

2.6. References

1. Arihara, K., 2006: Strategies for designing novel functional meat products. Meat Science, 74, 219–229.
2. Channon H.A., Kerr M.G., Walker P.J., 2004: Effect of Duroc content, sex and ageing period on meat and eating quality attributes of pork loin. Meat Science, 66, 1- 88.
3. De Vries A.G., Faucitano L., Sosnicki A., Plastow G.S., 2000: The use of gene technology for optimal development of pork meat quality. Food Chemistry, 69, 397-405.
4. Fernandez X., Monin G., Talmant A., Mourot J., Lebret B., 1999: Influence of intramuscular fat content on the quality of pig meat-2 – Consumer acceptability of m. longissimus lumborum. Meat Science, 53, 1, 67-72.
5. Fortin A., Robertson W.M., Tong A.K.W., 2005: The eating quality of Canadian pork and its relationship with intramuscular fat. Meat Science, 69, 297-305.
6. Goransson A., von Seth G., Tornberg E.1992: Influence of intramuscular fat on the eating quality of pork. In: Proceedings 38th International Congress of Meat Science and Technology, 23-28 VIII, Clermont Ferrand, France,. 245-248.
7. Klingberg, T.D., Axelsson, L., Naterstad, K., Elsser, D., Budde, B.B., 2005: Identification of potential probiotic starter cultures for Scandinavian-type fermented sausages. International Journal of Food Microbiology, 105, 419–431.
8. Ngapo, T. M,. Martin, J.-F. and E. Dransfield. 2007. International preferences for pork appearance: I. Consumer choices. Food Qual. Pref. 18: 26–36.
9. Rosenvold K., Andersen H.J., 2003: Factors of significance for pork quality – a review. Meat Science, 64, 219-237.
10. Żelechowska E., Przybylski W., Jaworska D., Santé-Lhoutellier V., 2012: Technological and sensory pork quality in relation to muscle and drip loss protein profile. European Food Research and Technology 234 (5), 883-894.

Summary of the overview of the scientific-research work

My scientific achievements are **83** papers, including **20** publications in the journals being indexed in the Journal Citation Report (JCR) list, **7** popular scientific publications and **21** publications in national and international scientific monographs.

The number of citations of my publications, according to the Web of Science database is equal to **204**, while according to the Google Scholar it is **427** and H-index (Hirsch Index) it is **9.**

Total Impact Factor of my publications (according to the JRC list, appropriate for the year of publication) is **28.265** while the 5-year Impact Factor for them is **37.004**.

Total number of points of my scientific papers is **772** points (according to the MSaHE – Ministry of Science and Higher Education list, appropriate for the year of publication). The number of points of my scientific papers published after achieving my Ph.D. degree is **729** points (according to the MSaHE list, appropriate for the year of publication).

3. Discussion of other research achievements.

With the Faculty of Human Nutrition and Consumer Sciences of Warsaw University of Life Sciences I have been in formal relation since15th October 1987, when I was employed as an assistant. Initially, until 1993, I was responsible for the study in the area of nutritional and technological suitability of new varieties of legumes seeds. The study was conducted in cooperation with the Institute of Plant Breeding and Acclimatization, Polish Academy of Sciences in Radzików.

In 2001, I was relegated to work on the organization of the Sensory Laboratory of Analysis at the Faculty of Human Nutrition and Consumer Sciences. Since then, until 2004, under the research supervision of prof. PhD. Baryłko-Pikielna I gained the basic knowledge and large experience in providing and organizing different sensory tests. These interests led to the preparation of the doctoral dissertation on the assessment of the importance of textural features in the overall sensory quality of selected food products. This work had gained distinction of Reviewers and the Faculty Council. I had prepared other publications in this field and they were published in highly valued foreign journals listed in JCR list.

Since 2005, together with prof. PhD Przybylski, I have been dealing with research regarding pork quality. It focuses especially on the conditions of sensory quality of meat. As a result of this research numerous scientific papers were prepared, many of which are listed on the of JCR list. In addition, long-term cooperation with the Institute of Food Technology in Bonn (Germany) and joint grants resulted in further important, high ranked publications.

I participated in the grant with the University of Life Sciences in Lublin in the years 2008-2010, which was related to the production of raw meat products ripened with the use of probiotics bacteria (two publications on the JCR list).

In 2010 I had a thirty-day internship in a scientific research Institute INRA, Theix, in France, where I had the opportunity to familiarize myself with the methodology regarding biochemistry of meat muscle. Earlier cooperation with the Institute, under the Polonium grant support, also resulted in a number of publications in reputable journals. In addition, I participated in a project financed by the European Regional Development Fund in the years 2014- 2015: Bioproducts, innovative technologies for healthy bakery products and pasta with a reduced-calorie. No POIG.01.03.01-14-041 / 12.

My work and scientific research focused on the following issues:
1) Technological quality of legumes seeds
2) Sensory quality of different food products
3) Sensory quality of food products enriched in polyunsaturated fatty acids omega-3 and fibre oat with a high content of β-glucans.

3.1. Technological quality of legume seeds

Dry soybeans contain up to 40% protein and bean, peas and lentils about 20% of protein. Soybeans contain high amount of fat (of about 20%). These kinds of fat are rich in polyunsaturated fatty acids, 60% linoleic acid and about 20% linoleic acid and

monounsaturated oleic acid. Nutritionists emphasize the need to consume legumes due to their content of various components important for digestion as well as dietary fiber fractions. These substances counteract the formation of human diseases. Many people avoid eating legumes because of long processing time of these seeds and digestive problems after their consumption.

Several years of research on legume seeds concentrated on technological aspects of pretreatment and cooking procedures of legumes seeds as well as the effect of seed storage on the water absorption. The studies have shown that selection of soybean varieties resulted in significant changes like less water uptake during soaking and the increase in the hardness of the seed after heat treatment. It was also shown that the coefficient of water absorption can be a good indicator of changes in seed storage regardless of the type of legumes. The results of this work are given in publications II.D.1- II.D.5.

3.2. Conditions of sensory quality of different foods

Food should not only be a necessary source of nutrients the human body needs, but also provide complete sensory satisfaction. Many studies on the factors determining the choice and the acceptance of foods concluded that usually the most important are the flavour and freshness of the product. That is why the sensory quality is subject to continuous interest of research centers, consumers, producers, and representatives of trade in food products.

The behaviour of the modern consumer results from the necessity of making choices related to a large variety of products as well as the development of new technologies and the growing role of information. Consumer research involved the analysis of consumers' behaviour in the market, including their relationship to the goods. The quality assessment is also used in sensory laboratory tests, which are conducted with the participation of skilled panels in the field of sensory evaluations. Laboratory sensory evaluations are to determine the quality of the sensory profile of the product and the intensity of specific sensory attributes selected during the preliminary session.

Preferences research of different beers of the pilsner type and a comparison of their quality profile showed significant differences between the tested samples; test results are given in the works II.D.6 and II.D.8.

Consumer research was also carried out in order to select the most preferred stuffing for dumplings, for appropriate cakes selection and the preferred methods of heat treatment. The results of this test are given in the work II.D.18. The study presented in the work II.D.30 regards the composition optimization of the recipe of granola bar as a result of consumer research. Additionally, the work II.D.20. presents the results of sensory tests (laboratory and consumer) of cottage cheese with different fat content. The comparison of the results from a laboratory test with a consumer test showed a high correlation with the results of both methods. Products with a higher fat content were rated higher, regardless of whether the consumers declared eating full-fat products, or products with reduced fat content.

3.3. Sensory quality of the food products enriched in polyunsaturated fatty acids and cereal products enriched in oat fibre with high β-glucans content

Preparations of EFAs are produced in a liquid form – the oil one and also in a microencapsulated form as odourless powder. For food fortification the form of triglycerides or fatty acids esterified with ethanol is most often used. These preparations can be used for enrichment, for example, butter-like pastes, milk, yoghurt, cheese, meat products, fruit drinks, cereals, breads, oils, salad, mayonnaise, ice cream, instant food concentrates and various nutrients for infants, children and adults.

Enrichment of foods in polyunsaturated fatty acids omega-3 by the addition of non-hydrogenated fish oil can significantly increase the level and improve the profile of

polyunsaturated fatty acids in the diet and in the body. However, due to the high susceptibility to oxidation of fish oil, fortified foods cannot be stored for long periods of time without additional technological processes and application of packaging with high barrier to oxygen. Oxidation destroys the health-promoting properties of fortified foods. The aroma and flavour of the food with the addition of fish oil may change significantly as far as sensory and chemical aspects are concerned. This process may take place during processing, packaging, storage, distribution and preparation for consumption.

For each type of food the levels of additives of polyunsaturated fatty acids were experimentally determined and the maximum acceptable additives due to the chemical and sensory test were examined. Placing in the food the chain fatty acids omega-3 caused a big problem due to the low oxidative stability of the fish oils (usually added to food), and their naturally occurring specific odour and flavour. During the research the possible upper levels of the additive formulations of fish oil into various food products instant, causing no significant reduction in sensory quality, were established.

The studies have shown that the stability of formulations microencapsulated with polyunsaturated acids as well as fortified foods depends on the storage time and conditions. It is indicated that the spray drying process used to prepare the microencapsulated formulation decreased the sensory profile of the product. The results of the study are presented in the work II.A.2, II.A.3, II.A.4, II.D.13.

The great role of dietary fiber in the prevention of many human diseases is confirmed by numerous studies. The report of the FAO/WHO recommends increasing consumption of foods rich in fiber in order to increase this component to a minimum intake of 25 g per day (WHO, 2003). It is known that fiber intake from diet is lower in human population than recommended. Hence, it is reasonable to enrich products low in this component, such as pasta or white bread, in additional fiber. These products can be fortified with fiber of different origin; from nutritional point of view one of the most preferred ones is oat fibre.

This preparation was added to pasta and rolls production at 4%, 8%, 12% and 16%. Laboratory sensory tests and consumer sensory tests were conducted. It has been shown that consumers who participated in the study were interested in pasta products and rolls with high fiber content or fiber-fortified. A large group of consumers prefers pasta, bread and rolls enriched with fiber at 12 and 16%. White bread and pasta with the addition of 16% fiber obtained the highest level of acceptability. In addition, sensory storage changes of enriched bread were studied. The literature data indicates rapid changes in storage of enriched bread in fibre compared to a control bread. The results of this work are given in publications sent for review in the end of 2015 to the editors of reputable journals. The works below are in the process of evaluation:

1. **Jaworska D**., Jeżewska-Zychowicz M., Wyrwisz J., Piwińska M., Moczkowska M., Wierzbicka A., The effect of oat fibre addition on sensory quality of fresh pasta. Journal of Food Science and Technology, *in review, 25 pkt MNiSW*
2. Królak M., **Jaworska D**., Jeżewska-Zychowicz M. The effect of storage on sensory quality of white rolls with fibre additon. Journal of Food Quality, *in review; 20 pkt MNiSW*

3.4. Summarizing the of scientific research work

My scientific work - research (excluding achieve of habilitation) can be summarized in the following conclusions:

- I set the importance of legumes seeds processing depending on a variety of storage conditions, soaking and heat treatment for their sensory quality;
- I identified the sensory quality of a number of foods products depending on applied technologies, different materials and the applied processing technology;
- I set the maximum possible levels of the additive preparation of fish oil for a variety of food products without significantly reducing their sensory quality;

- I set the optimum time and storage conditions for fortified foods with oat fibre due to the sensory criteria;
- I set sensory acceptance of fortified bread and pasta;
- I identified the sensory quality of enriched bread during 48 hours of storage.

4. Summary of scientific publications

In Table 1 the summary of all publications are presented.

Table 1. Summary of scientific publications with regard to Polish Ministry of Science and Higher Education scoring and Impact Factors

L. p	Publications	Number of publications		Polish Ministry scoring by year	Impact Factor by year	Sum of scoring based on Ministry scoring
		Before PhD	After PhD			
A. Publications published in scientific journals with impact factor Impact Factor (IF), in the database of Journal Citation Reports (JCR)						
1	Animal Science Papers and Reports	-	1	25	0.718	25
2	Archiv Tierzucht	-	1	15	0.612	15
3	BioMed Research International	-	1	20	1.579	20
4	European Food Research and Technology	-	1	30	1.436	30
5	European Food Research and Technology	-	1	24	1.159	24
6	Food Research International	-	1	40	3.150	40
7	Food Science and Technology Research	-	1	10	0.401	10
8	International Journal of Dairy Technology	-	1	24	0.647	24
9	International Journal of Food Science and Technology	-	1	25	1.259	25
10	Journal of Animal and Feed Sciences	-	1	15	0.692	15
11	Journal of the American Oil Chemists Society	-	1	20	1.137	20
12	Journal of the Science of Food and Agriculture	-	2	24	1.304	48
13	Meat Science	-	2	40	2.754	80
14	Meat Science	-	2	35	2.615	70
15	South African Journal of Animal Science	-	1	13	0.416	13
16	Żywność, Nauka, Technologia, Jakość	-	2	15	0.190	30
	Sum		**20**	**-**	**28.265**	**489**
B. Scientific papers published in journals listed in Part B of the MSaHE list without Impact Factor						
1	Animal Science Papers and Reports	-	1	4	-	4
2	Annals of Animal Science		1	3	-	6
3	Annals of Warsaw Agricultural University, Food Technology and Nutrition	1	-	3	-	3

L. p	Publications	Number of publications		Polish Ministry scoring by year	Impact Factor by year	Sum of scoring based on Ministry scoring
		Before PhD	After PhD			
4	Biuletyn Instytutu Hodowli i Aklimatyzacji Roślin	1	-	4	-	4
5	Bromatologia i Chemia Toksykologiczna	1	1	4	-	8
6	Electronic Journal of Polish Agricultural Universities		1	4	-	4
7	Folia Universitatis Agriculturae Stetinensis. Scientia Alimentaria	-	1	3	-	3
8	Handel Wewnętrzny	-	1	6	-	6
9	Polish Journal of Food and Nutrition Sciences	-	1	6	-	6
10	Polish Journal of Food and Nutrition Sciences	-	2	9	-	18
11	Postępy Nauki i Technologii Przemysłu Rolno-Spożywczego	-	2	2	-	4
12	Postępy Techniki Przetwórstwa Spożywczego	-	2	4	-	8
13	Przemysł Fermentacyjny i Owocowo-Warzywny	1	-	1	-	1
14	Przemysł Spożywczy	3	-	3	-	9
15	Roczniki Instytutu Przemysłu Mięsnego i Tłuszczowego	-	1	2	-	2
16	Roczniki Naukowe Polskiego Towarzystwa Zootechnicznego	-	1	4	-	4
17	Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu	-	1	8	-	8
18	Zeszyty Problemowe Postępów Nauk Rolniczych	-	2	6	-	12
19	Zeszyty Problemowe Postępów Nauk Rolniczych	-	1	9	-	9
20	Żywienie Człowieka i Metabolizm	2	1	4	-	12
21	Żywienie Człowieka i Metabolizm	-	2	2	-	4
22	Żywność, Nauka, Technologia, Jakość	-	1	15	-	15
23	Żywność, Nauka, Technologia, Jakość	-	5	4	-	20
24	Żywność, Nauka, Technologia, Jakość		1	13	-	13
	Sum	**9**	**29**	-	-	**180**

L. p	Publications	Number of publications		Polish Ministry scoring by year	Impact Factor by year	Sum of scoring based on Ministry scoring
		Before PhD	After PhD			
C. The chapters in scientific monographs in English						
1	Chapter in monographs	-	2	4	-	8
2	Chapter in monographs	-	3	5	-	15
3	Chapter in monographs	-	2	7	-	14
Sum		**-**	**7**	-	-	**37**
D. The chapters in scientific monographs in Polish						
1	Chapter in monographs	6	3	3	-	27
2	Chapter in monographs	-	5	4	-	20
Sum		**6**	**8**	-	-	**47**
E. Publications in the original-reviewed international journals not included in the list of the Minister						
1	SPIE Proc	-	1	4	-	4
2	Journées Sciences du Muscle et Technologies des Viandes	-	1	4	-	4
3	Journal of Culinary Science & Technology	-	1	4	-	4
4	Viandes & Produits Carnés	-	1	4	-	4
Sum		**-**	**4**	-	-	**16**
All publications		**83**			**28.265**	**772**