Evaluation of the impact of HPP treatment on the chemical composition and organoleptic indicators of raw dog food

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Abstract

The study included three diets of raw dog food made of different types of meat – chicken, veal and a mix of meats that were treated under high pressure. For this purpose, the non-thermal treatment technology – HPP (high pressure processing) was used. The aim of our study was to evaluate how this type of processing affected the chemical composition and organoleptic characteristics of three different types of raw dog food. To conduct the experiment, a total of 75 samples were examined, divided according to a scheme – 5 control and 20 samples from each diet. On the day of production before HPP treatment, 10 samples of these 20, were tested for chemical components – proteins, fats, saturated fatty acids, carbohydrates, sugars, chlorides, crude cellulose (fiber), energy value and organoleptic characteristics – appearance and shape, color, texture, smell. Ten samples from each diet treated with HPP, were tested for the same indicators.

Our results showed that the organoleptic and quality indicators of raw dog food, did not change significantly after HPP-treatment. That meant the technology could be successfully implemented in the production of raw dog food.

Key words: Raw dog food, HPP (high pressure processing), organoleptic indicators, chemical composition

Introduction

The feeding with raw food on dogs and cats was a new trend for our country and it was associated with a number of contradictions for both owners and the veterinarians. Nowadays, people were becoming more and more demanding of their diet. This significantly affected the choice of food for their pet. The search for high quality food with a beneficial effect on health leads to the growing popularity of diets for dogs and cats based on raw meat (Michel, 2006). However, this new practice was also the cause of a number of disagreement, as it posed a potential danger to both human and animal health (Freeman et al., 2013). It was no coincidence that most studies related to the nutrition of pets with raw foods were focused mainly on microbial contamination, due to the fact that this type of food did not undergo heat treatment (Lenz et al., 2009).

In our study we used the High pressure processing (HPP) in order to obtain a better quality and at the same time a safer product. The HPP treatment was a modern technological food processing used in the food industry in the world and very recently in Bulgaria.

The HPP treatment allowed decontamination of foods with minimal impact on their nutritional and sensory characteristics.The Changes that occur in meat products were mainly related to changes in color, texture and water retention capacity (Campus, 2010). Hugas et al. (2002) and Simonin et al. (2012) confirmed that the HPP use led to a reduction in microbial load, and according to them, the technology was most widely used in the production of meat products. Buckow and Heinz (2008) they discussed the influence of the HPP-treatment on the color and texture of meat products, as well as on the composition of proteins, fats and carbohydrates in them.

Aghamohammadi et al., 2014 also found a change in the color and texture of the meat as a result of the HPP processing.

The aim of our study was to evaluate the impact of HPP treatment on the quality of three raw dog foods.

Materials and methods

Composition of the three diets

A total of 75 samples of three dog raw foods were analyzed with the participation of different meats – chicken, veal and a mix of chicken, veal and pork in equal proportions. Table 1 presented in detail the component composition of the raw dog foods.

The diets were made of raw materials fit for human consumption, under the same conditions and were packaged in special vacuum packages that could stand high pressure, while meeting all production requirements for safety.

The HPP treatment was performed with “AVURE AV-20M high pressure treatment equipment” for microbiological reduction of food. The machine had the ability to adjust the pressure up to 660 MPa and with an operating temperature of 0–29 °C. Each diet were treated by HPP for 3 minutes at 6000 bar and then stored at 0–4°C throughout the experiment.

Packaging

The raw dog food was packed in individual vacuum packs, stand to high pressure, intended for contact with food and complying with the requirements of Regulation (EC) № 1935/2004. The food was packaged in high barrier polypropylene foils meeting the criteria ”Oxygen Transmission Rate” (OTR) < 5 and ”Water vapor transmission rate” (WVTR) < 5.

Test of the raw dog food for quality and organoleptic indicators

To conduct the experiment 5 controls and 20 samples were tested from each diet. On the day of production before HPP-treatment, 10 samples of these 20, were tested for quality indicators – proteins, fats, saturated fatty acids, carbohydrates, sugars, chlorides, crude cellulose (fiber), energy value and organoleptic characteristics – appearance and shape, color, texture, odour. Ten samples from each diet treated with HPP, were tested for the same indicators.

The tests were performed in an accredited laboratory according to ISO / IEC 17025: 2017, and for each of the indicators the following test methods were used:

• Organoleptics (appearance and shape, color, texture, smell) – ISO 9381: 1979 – Meat products. Organoleptic examination;

• Protein – ISO 9374:1982 Meat and meat products. Determination of protein content;

• Fats – ISO 8549:1992 Meat and meat products. Determination of fats;

• Saturated fatty acids – ISO 12966-4:2015 - Animal and vegetable fats and oils – Gas chromatography of fatty acid methyl esters – Part 4:

Table №1. Component composition of the diets

Diet	Ingredients
Diet № 1	Veal, chicken by-products, spinach, apple, egg with shell, yoghurt, olive oil
Diet № 2	Ground chicken, beef liver, apple, zucchini, egg with shell, cottage cheese, olive oil
Diet № 3	Veal, chicken, pork, beef liver, chicken hearts, carrots, egg with shell, yoghurt, olive oil

Determination by capillary gas chromatography;

• Carbohydrates – Internally validated laboratory method 44/2013;

• Sugars – Internally validated laboratory method 71/2016

• Chlorides – ISO 7168:1993 – Processed fruit, vegetable and meat products. Meat and meat-vegetable tins. Methods of chloride content determination.

• Crude cellulose (fiber) – ISO 5498:1999 Agricultural food products – Determination of crude fibre content – General method;

• Energy value – Internally validated laboratory method 72/2016.

Statistical analysis

The data were analyzed using a linear model for one-way analysis using the software program Statistica for Windows. Confidence between groups was calculated by t-test at $P < 0.05$ and $P < 0.01$.

Results and discussion

Many scientists reported that the raw dog food could be produced by raw materials fit for human consumption (Weese et al., 2005, Mehlenbacher et al., 2012, Van Bree et al., 2018). On the other hand, Regulation (EC) 142/2011 laid down that animal by-products which were categorized in category III in Regulation (EC) 1069/2009 might also be used for dog food production. However, the use of meat and complementary raw materials intended for human consumption implies a higher quality of the final product, which was one of the motives of owners of raw nutrition, as noted by Freeman et al. (2013). Precisely in order to produce dog food with a higher level of quality and safety compared to the widely available in the commercial network, used raw materials for food production for our experiment were fit for human consumption.

Chemical composition

The results for the chemical indicators for the diet № 1 before and after the HPP-treatment were presented in Table 2. The table showed that no significant change was observed in any of the researched parameters. Exceptions were fats, which showed an increase after HPP-treatment with 9.1%. The change in the fat content was due to the high – pressure treatment. However, these differences were not significant. In support of our results were those of Campus (2010), who did not observe a significant change in food quality indicators after HPP-treatment. In the other indicators, the changes in the percentage content were statistically insignificant. The processing of raw food under high pressure did not change the energy value, which depended on other indicators.

Before and after HPP treatment, the studied chemical traits for diet № 2, did not show significant differences. The data from the obtained results were shown in Table 3. The change of indi-

Table 2. Chemical components before and after HPP treatment of diet № 1

Name of indicator	Measuring unit	Before HPP treatment	After HPP treatment
Proteins	%	15.18 ± 0.11	15.24 ± 0.12
Fats	%	16.5 ± 0.4	18.0 ± 0.5
Saturated fatty acids	g/100	6.81 ± 0.34	6.90 ± 0.35
Carbohydrates	%	1.05 ± 0.11	1.15 ± 0.20
Sugars	%	0.62 ± 0.06	0.69 ± 0.07
Chlorides	%	1.00 ± 0.01	1.08 ± 0.01
Crude cellulose (fiber)	%	< 0.5	< 0.5
Energy value	kcal/100g	213.1	215.04
	kJ/100g	880.3	892.19

cators was due to high-pressure treatment, with an increase in fat by 6.15% and carbohydrates by 7.56%, but these changes were not statistically significant. There was also a change in the energy value by 4.9%, which was due to changes in other quality indicators, but the increase was also not statistically significant. The lack of a significant change in the values for protein, fat, saturated fatty acids, carbohydrates, sugars, chlorides, crude cellulose (fiber) and energy value in our samples confirmed the claims of Bermúdez-Aguirre and Barbosa-Cánovas (2011) and Chiao et al. (2014) that this non-thermal treatment did not affect the quality and nutritional value of the food.

With the data presented in Table № 4, we could confirm the results obtained by us for the previous two diets. Here there was a change in the chemical indicators, again there was an increase in fat, but by 3.03%, and in carbohydrates by 5.12%. Again, we had a slight change in energy value. Our claims were supported by the results obtained by Campus (2010), which found that HPP processing did not lead to a significant change in the quality and nutritional value of food.

The influence of HPP-treatment on the organoleptic characteristics of raw dog food

The data for the organoleptic evaluation of raw food with veal meat were presented in Table 5. The results showed that the change after processing occurred only in the color of the food. In support of our findings were the results of studies conducted by Carlez et al. (1995). The change in color (lightening) had also been described by Cheftel and Culioli (1997), and the authors explained it as a consequence of denaturation of

Table 3. Chemical components before and after HPP treatment of diet № 2

Name of indicator	Measuring unit	Before HPP treatment	After HPP treatment
Proteins	%	14.34 ± 0.10	14.41 ± 0.10
Fats	%	13.0 ± 0.3	13.8 ± 0.3
Saturated fatty acids	g/100	4.32 ± 0.22	4.32 ± 0.22
Carbohydrates	%	1.85 ± 0.19	1.99 ± 0.20
Sugars	%	0.41 ± 0.04	0.52 ± 0.04
Chlorides	%	0.19 ± 0.01	0.16 ± 0.01
Crude cellulose (fiber)	%	< 0.5	0.73 ± 0.07
Energy value	kcal/100g	181.8	190.72
	kJ/100g	750.7	787.67

Table № 4. Chemical components before and after HPP treatment of diet № 3

Name of indicator	Measuring unit	Before HPP treatment	After HPP treatment
Proteins	%	15.03 ± 0.11	15.09 ± 0.11
Fats	%	16.5 ± 0.4	17.0 ± 0,.4
Saturated fatty acids	g/100	6.60 ± 0.34	6.61 ± 0.34
Carbohydrates	%	1.56 ± 0.16	1.64 ± 0.33
Sugars	%	1.20 ± 0.12	1.21 ± 0.12
Chlorides	%	0.51 ± 0.01	0.61 ± 0.01
Crude cellulose (fiber)	%	< 0.5	< 0.5
Energy value	kcal/100g	214,9	217.9
	kJ/100g	859.4	881.45

myoglobin in the muscle fibers of meat and meat products.

In terms of consistency and odor, the food we studied did not show significant changes after HPP-treatment, in contrast to the results indicated by Campus (2010), where the author reported a slight change in the texture of the samples he studied.

Table 6 presented the data for organoleptic indicators for the diet № 2. The results of the diet containing poultry meat did not differ significantly from the diet with veal. As with the veal diet, there was a slight discoloration. The pale pink-brown color characteristic of chicken meat had faded slightly. Again, no differences in the product before and after HPP treatment were observed with respect to other organoleptic characteristics.

Table 7 presented the results of organoleptic tests for diet № 3. As could be seen, we again observed similar results as in the previous two diets. We had a change in the organoleptic characteristic only for the color indicator. Again, as a result of the treatment, a change in color was observed from darker to lighter.

Changes in the appearance, texture, and odor of the food due to HPP technology were not observed in the third diet.

Conclusion

After the HPP-treatment, there were no significant changes in the quality indicators protein, fat, saturated fatty acids, carbohydrates, sugars, chlorides, crude cellulose (fiber), energy value, as well as in organoleptic (appearance and shape, color, texture, odor). That mean the technology

Table 5. Organoleptic indicators before and after HPP treatment of Diet № 1

Organoleptic indicators	Before HPP treatment	After HPP treatment
Appearance and shape	Finely ground fat-free veal with a clean surface, free of mechanical contamination and sliming.	Finely ground fat-free veal with a clean surface, free of mechanical contamination and sliming.
Color	Red, typical of veal.	Pale red, typical of veal
Consistency	Tightly elastic	Tightly elastic
Smell	Characteristic of fresh meat and raw materials	Characteristic of fresh meat and raw materials

Table № 6. Organoleptic indicators before and after HPP treatment of Diet № 2

Organoleptic indicators	Before HPP treatment	After HPP treatment
Appearance and shape	Finely ground fat-free chicken with a clean surface, free of mechanical contamination and sliming.	Finely ground fat-free chicken with a clean surface, free of mechanical contamination and sliming.
Color	Pink-brown.	Pale pink-brown.
Consistency	Tightly elastic	Tightly elastic
Smell	Characteristic of fresh meat and raw materials	Characteristic of fresh meat and raw materials

Table 7. Organoleptic indicators before and after HPP treatment of Diet № 3

Organoleptic indicators	Before HPP treatment	After HPP treatment
Appearance and shape	Finely ground fat-free meat with a clean surface, free of mechanical contamination and sliming.	Finely ground fat-free meat with a clean surface, free of mechanical contamination and sliming.
Color	Pink-brown.	Pale pink-brown.
Consistency	Tightly elastic	Tightly elastic
Smell	Characteristic of fresh meat and raw materials	Characteristic of fresh meat and raw materials

could be successfully implemented in the production of raw dog food.

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ISO 8549:1992 Meat and meat products. Determination of fats

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