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PREDICTION OF INTRAMUSCULAR FAT CONTENT OF THE RABBITS' HIND LEG MEAT USING THE NIRS TECHNIQUE

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1. INTRODUCTION

The group of the quick, near-infrared spectroscopy (NIRS) methods, which needs no dissolver are widely used in the qualification of the stock and end-product of agriculture and food industry (ROMVÁRI et al., 2006). Contrary to the chemical analysis, NIRS requires no reagent, so the cost of the analysis is decreased, and there is no environmental incidence (UDDIN and OKAZAKI, 2004). The NIR technique is appropriate for qualitative analysis – to identify different meats by species (MC ELHINNEY et al., 1999) - and for quantitative analysis - estimating chemical composition of different foods and feeds (KAFFKA et al., 1982; XICCATO et al., 2003; BÁZÁR and ROMVÁRI, 2009).

In rabbit breeding the first NIRS application occurred more then 20 years ago on living animals (MASOERO et al., 1992). XICCATO et al. (2003) applied this technique to predict the chemical constituents, digestibility and energy value of 164 compound feeds for rabbits using harmonised methods in six European institutes. ROMVÁRI et al. (2006) searched the feasibility of NIRS on fat content determination of rabbit meat. Their aim was also to develop calibration equations on rabbit meat samples. BÁZÁR et al. (2007) developed calibration equations to predict the protein and intramuscular fat content of raw, homogenized rabbit meat by means of NIRS. PLA et al. (2007) examined the use of feasibility of NIRS from qualitative aspect, to discriminate between rabbits meats, produced in conventional or organic systems. RIOVANTO et al. (2009) obtained two hundreds rabbits from 3 different maternal lines and 5 paternal lines, for a total of 11

combinations. The fresh hind legs and Longissimus dorsi muscles were analyzed for chemical composition and fatty acid profile by near infrared spectroscopy. Beside the quantitative analysis the researchers also made qualitative analysis. They tried to discriminate samples according to their genetic origin. ZOMEÑO et al. (2011) adopted NIRS for the determination of intramuscular fat content in rabbit selection programmes. According to their results the NIRS technique could be successfully used in truncated selection. This procedure is also widely applied in pig and poultry breeding. Then ZOMEÑO et al. (2012) made further investigations to estimate the use of NIRS for predicting fatty acid content in intramuscular fat to be applied in rabbit selection programs.

The aim of the study is to estimate the intramuscular fat predicted by NIRS technique and its phenotypic correlation with different slaughter traits of 11 weeks old growing rabbits.

2. MATERIAL AND METHODS

Animals

The research carried out analyzing the records of 80 Pannon White rabbits, born and kept at the experimental rabbit farm of the Kaposvár University. Growing rabbits were housed in fattening cages (2-3 rabbits per cage). After weaning at 5 weeks of age all rabbits were fed *ad libitum* a commercial pellet, water was offered *ad libitum* from nipple drinkers.

Meat samples

Rabbits were slaughtered at 11 weeks of age at the body weight of 2.2-3.3 kg, at the slaughter house of OLÍVIA Ltd. in Lajosmizse. The carcasses were dissected according to the WRSA recommendation (BLASCO and OUHAYON, 1996). Each animal was measured before the slaughter. All rabbits were slaughtered by electrical stunning and exsanguinations. Then hot carcass was measured (together with head, heart, lung, liver, kidneys, scapular- and perirenal fat), then it was stored at 4 ˚C for 24 h. The chilled

carcass was measured again with the head and insides. The reference carcass was cut between the 7. and 8. vertabra, and the 6. and 7. lumbar vertebra. The following traits were collected: body weight at slaughter (g), hot carcass weight (g); chilled carcass weight (g); reference carcass weight (g); thigh muscle weight (g); Longissimus dorsi muscle weight (g); dressing out percentage (%); perirenal fat weight (g); scapular fat weight (g); ratio of front-, mid- and hind part (to the reference carcass weight). Total deboned left thigh muscles were cut up and freeze-dried (Christ Alpha 1-4). Freeze-dried samples were homogenized (IKA A11 basic) before scanning.

Chemical analyses

From the calibration dataset of BÁZÁR et al. (2007) all freeze-dried samples (n=89) was used for chemical analyses. The fat content of the samples was determined according to FOLCH et al. (1957). Chemical data were used and given on a dry matter basis (BÁZÁR et. al; (2007). The true chemical component of the predicted dataset of this study (n=80) was unknown.

NIRS analyses

The freeze-dried homogenized meat samples were measured by Foss NIRSystem 6500 spectrometer (Foss NIRSystems INC., Silver Spring, MD, USA), equipped with a sample transport module and a small ring cup cuvette. Reflectance spectra were taken from 400-2500 nm region and recorded as log(1/R) at 2 nm intervals. The WinISI II version 1.5 spectral analytical software (IntraSoft International, Port Matilda, PS, USA) was utilized for the operation of the scanner and for the development of the analytical procedures. Each freeze-dried homogenized sample was scanned ten times. The average spectrum was used for NIR analysis. Partial least squares (PLS) regression was used in order to set Local equation (SHENK et al., 1997) for quantitative analysis. Standard normal variance (SNV) and Detrend were applied for correction of the scattering effect. The sloping background was removed by the second derivative of the spectra (TAHBOUB and PARDUE, 1985). A gap (8 nm) and a smoothing interval (6 nm) were used to reduce

sample-to-sample baseline variation and to enhance the absorption peaks. The calibration equation that was developed by BÁZÁR et al. (2007) contain 89 records, was used to predict the intramuscular fat content of 80 samples of the present study coming from an independent experiment. The true chemical composition was unknown for the predicted dataset. For the prediction to archive the best results the whole interval of 1100-2500 was used.

The phenotypic correlations and the differences of the male and female rabbits concerning the slaughter traits were evaluated by SAS 9.1.3 software using PROC CORR and PROC TTEST, respectively.

3. RESULTS AND DISCUSSION

Descriptive statistics for the predicted dataset (Experiment 1) are shown in Table 1.

Table 1: Descriptive statistics of chemical data of sample set

Experiment 1 (n=80)				
	Mean	**SD**	**Min.**	**Max.**
Fat (%)	4.20	1.57	2.01	9.66

Using freeze-dried samples the evaluation of spectra improved through decreasing water content. The average of NIRS predicted value for intramuscular fat was 4.2% when using freeze-dried samples, respectively. The minimum and maxim values showed a substantial fluctuation of predicted fat percentages. The present NIRS prediction for intramuscular fat content was similar with the value reported by ROMVÁRI et al. (2006). BÁZÁR et al. (2007) reported higher value for intramuscular fat content.

Rabbits are good experimental material for genetic studies due to their reduced generation interval and low cost of the carcasses (ZOMEÑO et al. 2011).

The estimates of correlations can be seen in Table 2.

Table 2: Estimates of phenotypic correlation. Standard errors of estimates are given in brackets

Experiment 2 (n=80)					
Traits	**Fat (%)**	**Live body weight (g)**	**Chilled carcass weight (g)**	**Perirenal fat weight (g)**	**Scapular fat weight (g)**
Fat (%)	1.00000	0.35 (0.018)	0.43 (<.0001)	0.55 (<.0001)	0.34 (0.0029)

Phenotypic correlation coefficients estimated between intramuscular fat content and live body weight; chilled carcass weight; scapular fat weight and perirenal fat weight were low and moderate (0.35, 0.43, 0.34 and 0.55, respectively). No significant difference was found between the male and female rabbits concerning their slaughter traits.

4. CONCLUSION

A successful NIRS calibration for predicting intramuscular fat content by BÁZÁR et al. (2007) is justified by the current study. NIRS is a proper alternative for determination of intramuscular fat content. Further investigation is needed to evaluate the importance of the intramuscular fat predicted by NIRS technique in the breeding program of rabbits.

5. SUMMARY

Several studies are concerned with the analysis of the chemical composition and fatty acid profile of the rabbit meat by rapid and accurate technical tool (NIRS), instead of using laborious chemical methods. The aim of the study was to estimate the intramuscular fat predicted by NIRS technique and its phenotypic correlation with different slaughter traits of 11 weeks old growing rabbits. Investigation was carried out on 180 Pannon White rabbits that were reared at the rabbit farm of Kaposvár University. Rabbits were slaughtered at 11 weeks of age at the body weight of 2.2-3.3 kg. Total deboned left thigh muscles were cut up and freeze-dried (Christ Alpha 1-4). Freeze-dried samples were homogenized (IKA A11 basic) before scanning. Homogenised freeze-dried meat samples were measured by Foss NIRSystem 6500 spectrometer (Foss NIRSystems INC., Silver Spring, MD, USA) equipped with a sample transport module and a small ring cup cuvette. Reflectance spectra were taken from 400-2500 nm region and recorded as log(1/R) at 2 nm intervals. Each freeze-dried homogenized sample was scanned ten times. Partial least squares (PLS) regression was used in order to set Local equation (Shenk et al., 1997) for quantitative analysis. Phenotypic correlation coefficients estimated between intramuscular fat content and live body weight; chilled carcass weight; scapular fat weight and perirenal fat weight were low and moderate (0.35, 0.43, 0.34 and 0.55, respectively). No significant difference was found between the male and female rabbits concerning their slaughter traits.

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