Section C9.15

The effect of ultrasound probe on accuracy of intramuscular fat content and marbling prediction in beef longissimus dorsi muscle

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Introduction

A frequency of ultrasound probe is one of the main factors influencing ultrasound images. It is known, than when high frequency probe is used, the ultrasound penetrates deeper but on the other hand the images obtained with lower frequency probe are more detailed. The aim of this paper was to evaluate the effect of probe frequency on intramuscular fat content and marbling prediction.

Material and Methods

The study was carried out on 142 bulls of which 74 Slovak Spotted, 6 Pinzgauer 22 Holstein, 20 Beef Simmental and 20 Charolais. Within this research ALOKA SSD-500 ultrasound machine with two different ultrasound probes was used; 5 MHz/ 64 mm and 3.5 MHz/ 172 mm. Ultrasound images were obtained between 12th and 13th rib one week before slaughter. Taking into account previous results the ultrasound machine performance of 60, 65 and 70% was applied when 5 MHz probe was used (values were entitled as SONO_60, SONO_65 and SONO_70) and performance of 75, 80, 85 and 90% was applied when 3.5 MHz probe was used (values entitled as SONO_75, SONO_80, SONO_85 and SONO_90). A dissection was performed 24 hours after slaughter. Cross-sectional cut of musculus longissimus thoracis et lumborum was performed between 12th and 13th rib. Then the photograph of cross section area was taken. Value of photograph image was entitled as MARB. Subsequently, the meat sample was taken for laboratory determination of intramuscular fat content using Infratec 1265 – Meat Analyzer. The obtained values were entitled as intramuscular fat content (IMF). For data evaluation SAS 8.2 software was used. STAT (Basic Statistics) module and CORR (Correlation analysis) procedure were applied.

Results and Discussion

When 5 MHz probe was used mean SONO values were rising as the ultrasound machine performance was increasing. They varied from 1.60 (SONO_60) to 4.74% (SONO_70) as shown in Table 1. When 3.5 MHz probe was used mean SONO values were also rising as ultrasound intensity was rising. They ranged from 0.58 to 3.98% (Table 2). Mean value of marbling determined from photographic images (MARB) was 2.19% and mean value of laboratory determined intramuscular fat content (IMF) was 2.39%.

Table 1 Basic statistics (5 MHz probe)

Characteristic	Mean	Standard Deviation
SONO_60	1.60	1.579
SONO_65	2.76	2.583
SONO_70	4.74	3.879
MARB	2.19	0.835
IMF	2.39	1.144

Table 2 Basic statistics (3.5 MHz probe)

Characteristic	Mean	Standard Deviation
SONO_75	0.58	0.64
SONO_80	1.36	1.249
SONO_85	2.24	1.637
SONO_90	3.98	2.284
MARB	2.19	0.835
IMF	2.39	1.144

The statistically significant ($P < 0.001$) correlations between single ultrasound measurements were found when 5 MHz or 3.5 MHz probe was used (Table 3, Table 4). When high frequency probe was used, the highest correlation ($r = 0.26$) was obtained applying 65% of overall ultrasound machine performance. When performance of 60 and 70% was applied the correlation coefficients were $r = 0.14$ for both measurements and were not statistically significant. Also no statistically significant correlations were observed between SONO values and laboratory determined intramuscular fat content. When low frequency probe (3.5 MHz) was used, neither the significant correlations between SONO and MARB values, nor the significant correlations between SONO and IMF values were calculated, except for correlation between SONO_80 and MARB; $r = 0.25$ ($P = 0.09$).

Table 3 Pearson's correlation coefficients (5 MHz probe)

	SONO_65	SONO_70	MARB	IMF
SONO_60	**0.65*****	**0.72*****	0.14	-0.14
SONO_65		**0.88*****	**0.26**	-0.07
SONO_70			0.14	-0.18

*** - $P < 0.001$, ** - $P < 0.01$, * - $P < 0.05$

Table 4 Pearson's correlation coefficients (3.5 MHz probe)

	SONO_80	SONO_85	SONO_90	MARB	IMF
SONO_75	**0.65*****	**0.65*****	**0.55*****	0.10	0.04
SONO_80		**0.79*****	**0.64*****	**0.25**	-0.05
SONO_85			**0.70*****	0.09	-0.08
SONO_90				0.07	-0.19

*** - $P < 0.001$, ** - $P < 0.01$, * - $P < 0.05$

Results obtained using different probes were almost similar. Statistically significant were only correlations between single ultrasound measurements. When comparing the correlations between SONO and MARB values it can be seen the values of correlation coefficients are almost similar for high and low frequency probe. No differences can be observed also when correlations between SONO values and laboratory determined intramuscular fat content (IMF) are compared.

Conclusion

According to results the hypothesis that ultrasound probe influences the accuracy of marbling and intramuscular fat content prediction was not proved.

On the other hand, taking into account these results it should be said that the optimal ultrasound intensity has to be applied when particular probe is used in combination with particular ultrasound machine (Picture 1 and 2). The optimal performance for ultrasound machine ALOKA SSD – 500 was proposed; 65% (5 MHz probe) and 80% (3.5 MHz probe).

Appendix

Figure 1 Correlation coefficients (5 MHz probe)

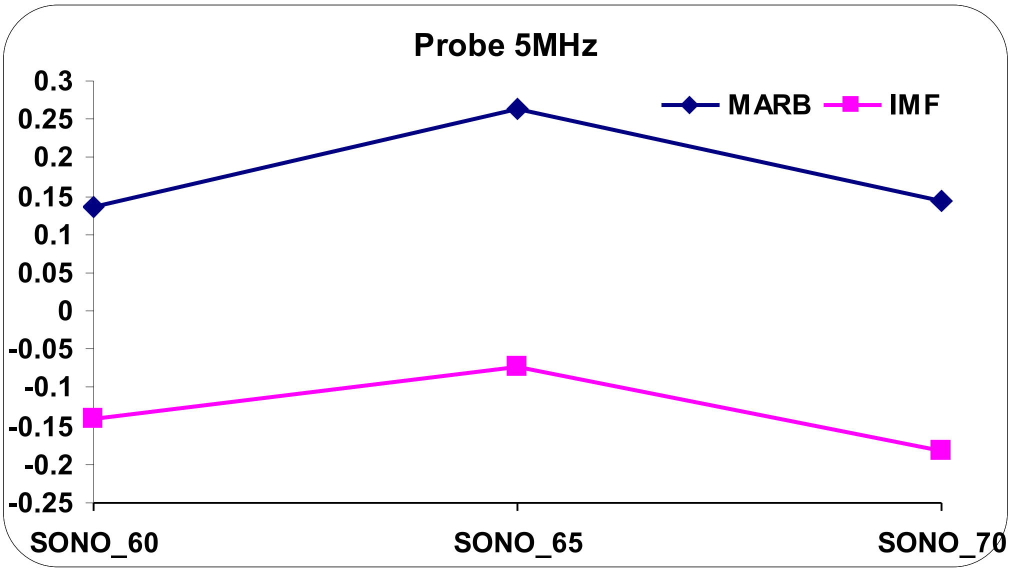

Figure 2 Correlation coefficients (3.5 MHz probe)