Ultrasonography as a method to determine body composition in cattle

Christophe STAUB – INRA Val de Loire – UE1297 PAO – Nouzilly – France

EAAP Belfast – September 1st, 2016
INTRODUCTION

- Estimation of body composition in live cattle is difficult
- Body condition score
- Adipose cell number and diameter (Robelin, 1981)
- Ultrasonography (for review see Schröder and Staufenbiel, 2006)
- Three-dimensional camera (Fisher et al., 2015; Spoliansky et al., 2016)
INTRODUCTION

- Estimation of body composition in live cattle is very useful
- Good knowledge of body condition in a herd
- Optimization of nutrition program
- Optimization of reproduction management
- Better production and longevity of animals in herd
- Best rentability of animals at slaughter
AIMS

✓ Validate a reference methodological framework to measure body fatness using ultrasonography

✓ Compare the results obtained at 4 anatomical sites and their relevance to the Body Condition Score

✓ Take advantage of the genetic wealth of INRA herds to generate reference data for 5 breeds
EXPERIMENTAL DESIGN

- 160 cows measured twice
- 5 different breeds: Normande, Holstein, Montbéliarde, Charolaise and Salers
- 4 anatomical sites: buttock, lumbar, back, and rib
- 14688 ultrasound measures: skin, fat, and muscles thickness
- 2 different ultrasound devices: Prosound (Aloka) and MyLab 30 Gold Vet (Esaote Pie Medical)
- Weight and BCS were measured at each ultrasound session
### METHODOLOGY

<table>
<thead>
<tr>
<th>Site</th>
<th>Anatomical landmark</th>
<th>Ultrasonic landmark</th>
<th>Fréquence (MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>half way between the tip of the hip and the tip of the ischium</td>
<td>below the biceps femoris, to the intersection between the gluteus</td>
<td>5</td>
</tr>
<tr>
<td>L</td>
<td>at the level of the 4th lumbar vertebra between the 2nd and 3rd transverse processes</td>
<td>at the recess of the fourth lumbar vertebra</td>
<td>5</td>
</tr>
<tr>
<td>B</td>
<td>in the back, in the range between the 12th and the 13th ribs</td>
<td>at the minimum thickness of the loin (longissimus dorsi)</td>
<td>3.5</td>
</tr>
<tr>
<td>R</td>
<td>in the range between the 12th and the 13th ribs, at the end of the 13th rib</td>
<td>at the end of the 13th rib, identifying the intercostal muscles and the peristaltic movements of the intestine</td>
<td>5</td>
</tr>
</tbody>
</table>
ULTRASONOGRAPHY

The F site at the buttock
ULTRASONOGRAPHY

The L site at the lumbar L4

Christophe STAUB / Ultrasonography as a method to determine body composition in cattle

EAAP Belfast / Sept 1st, 2016
ULTRASONOGRAPHY

The B site at the back D12-13
ULTRASONOGRAPHY

The R site at the end of the 13th rib
VALIDATION OF THE METHOD

<table>
<thead>
<tr>
<th></th>
<th>Repeatability (variation in %)</th>
<th>Reproducibility (variation in %)</th>
<th>Variation between experimenters (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FS</td>
<td>4.11</td>
<td>3.13</td>
<td>6.57</td>
</tr>
<tr>
<td>FSA</td>
<td>1.53</td>
<td>4.22</td>
<td>6.64</td>
</tr>
<tr>
<td>FSAM</td>
<td>0.41</td>
<td>3.04</td>
<td>4.74</td>
</tr>
<tr>
<td>LS</td>
<td>3.55</td>
<td>3.45</td>
<td>3.31</td>
</tr>
<tr>
<td>LSA</td>
<td>1.71</td>
<td>4.02</td>
<td>5.43</td>
</tr>
<tr>
<td>LSAM</td>
<td>0.65</td>
<td>3.72</td>
<td>3.39</td>
</tr>
<tr>
<td>BS</td>
<td>3.58</td>
<td>6.24</td>
<td>5.56</td>
</tr>
<tr>
<td>BSA</td>
<td>2.49</td>
<td>10.60</td>
<td>4.69</td>
</tr>
<tr>
<td>BSAM</td>
<td>1.43</td>
<td>6.34</td>
<td>5.86</td>
</tr>
<tr>
<td>RS</td>
<td>2.64</td>
<td>7.29</td>
<td>4.06</td>
</tr>
<tr>
<td>RSA</td>
<td>2.80</td>
<td>3.89</td>
<td>5.81</td>
</tr>
<tr>
<td>RSAM</td>
<td>0.54</td>
<td>10.57</td>
<td>5.22</td>
</tr>
</tbody>
</table>

F : buttock  
L : lumbar  
B : back  
R : rib  
S : skin  
A : adipose tissue  
M : muscles
Results

Fat and muscle at the lumbar site of Normande cows

R = 0.856
RESULTS

Fat and muscle at the lumbar site of Normande cows

R = 0.787
RESULTS

Fat and muscle at the lumbar site of Holstein cows

$R = 0.776$
RESULTS

Fat and muscle at the lumbar site of Holstein cows

\[ R = 0.447 \]
RESULTS

Fat and muscle at the lumbar site of Montbeliarde cows

R = 0.749
RESULTS

Fat and muscle at the lumbar of Charolaise cows

R = 0.366
RESULTS

Fat and muscle at the lumbar site of Salers cows

R = 0.283
RESULTS

Fat at the buttock of Normande cows

R = 0.787
RESULTS

Fat at the buttock of Holstein cows

R = 0.634
RESULTS

Fat at the buttock of Charolaise cows

R = 0.484
**RESULTS**

<table>
<thead>
<tr>
<th>Breed</th>
<th>N</th>
<th>BCS Range</th>
<th>BCS</th>
<th>WEIGHT</th>
<th>BCS Range</th>
<th>BCS</th>
<th>WEIGHT</th>
<th>BCS Range</th>
<th>BCS</th>
<th>WEIGHT</th>
<th>BCS Range</th>
<th>BCS</th>
<th>WEIGHT</th>
<th>BCS Range</th>
<th>BCS</th>
<th>WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHAROLAISE</td>
<td>318</td>
<td>1 to 4.25</td>
<td></td>
<td></td>
<td>2 to 3</td>
<td></td>
<td></td>
<td>1.25 to 3.5</td>
<td></td>
<td></td>
<td>1.75 to 4.5</td>
<td></td>
<td></td>
<td>0.5 to 4.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BCS</td>
<td>BCS</td>
<td>WEIGHT</td>
<td>BCS</td>
<td>WEIGHT</td>
<td>BCS</td>
<td>WEIGHT</td>
<td>BCS</td>
<td>WEIGHT</td>
<td>BCS</td>
<td>WEIGHT</td>
<td>BCS</td>
<td>WEIGHT</td>
<td>BCS</td>
<td>WEIGHT</td>
<td>BCS</td>
<td>WEIGHT</td>
</tr>
<tr>
<td>FSA</td>
<td>0.48427</td>
<td>0.45411</td>
<td>0.47931</td>
<td>0.04137</td>
<td>0.78750</td>
<td>0.51485</td>
<td>0.63373</td>
<td>0.37075</td>
<td>0.44662</td>
<td>0.28013</td>
<td>0.73220</td>
<td>0.63857</td>
<td>0.73447</td>
<td>0.47599</td>
<td>0.65943</td>
<td>0.37726</td>
</tr>
<tr>
<td>FSAM</td>
<td>0.25288</td>
<td>0.36256</td>
<td>0.44049</td>
<td>0.46138</td>
<td>0.73290</td>
<td>0.60798</td>
<td>0.85637</td>
<td>0.78742</td>
<td>0.74901</td>
<td>0.60798</td>
<td>0.85637</td>
<td>0.78742</td>
<td>0.77556</td>
<td>0.44703</td>
<td>0.69266</td>
<td>0.41528</td>
</tr>
<tr>
<td>LSA</td>
<td>0.43565</td>
<td>0.42319</td>
<td>0.45668</td>
<td>0.17980</td>
<td>0.76497</td>
<td>0.54424</td>
<td>0.65273</td>
<td>0.34558</td>
<td>0.54084</td>
<td>0.34313</td>
<td>0.76497</td>
<td>0.54424</td>
<td>0.65273</td>
<td>0.34558</td>
<td>0.65273</td>
<td>0.34558</td>
</tr>
<tr>
<td>LSAM</td>
<td>0.36647</td>
<td>0.44287</td>
<td>0.28303</td>
<td>0.37743</td>
<td>0.74901</td>
<td>0.60798</td>
<td>0.85637</td>
<td>0.78742</td>
<td>0.74901</td>
<td>0.60798</td>
<td>0.85637</td>
<td>0.78742</td>
<td>0.77556</td>
<td>0.44703</td>
<td>0.69266</td>
<td>0.41528</td>
</tr>
<tr>
<td>BSA</td>
<td>0.40610</td>
<td>0.48808</td>
<td>0.29015</td>
<td>0.07486</td>
<td>0.66485</td>
<td>0.47642</td>
<td>0.49365</td>
<td>0.25438</td>
<td>0.44237</td>
<td>0.19984</td>
<td>0.66485</td>
<td>0.47642</td>
<td>0.49365</td>
<td>0.25438</td>
<td>0.44237</td>
<td>0.19984</td>
</tr>
<tr>
<td>BSAM</td>
<td>0.38195</td>
<td>0.28755</td>
<td>0.32921</td>
<td>0.23983</td>
<td>0.73293</td>
<td>0.54433</td>
<td>0.57727</td>
<td>0.35708</td>
<td>0.62024</td>
<td>0.55396</td>
<td>0.73293</td>
<td>0.54433</td>
<td>0.57727</td>
<td>0.35708</td>
<td>0.62024</td>
<td>0.55396</td>
</tr>
<tr>
<td>RSA</td>
<td>0.38108</td>
<td>0.34267</td>
<td>0.23753</td>
<td>0.14122</td>
<td>0.69266</td>
<td>0.41528</td>
<td>0.55108</td>
<td>0.35144</td>
<td>0.39515</td>
<td>0.14367</td>
<td>0.69266</td>
<td>0.41528</td>
<td>0.55108</td>
<td>0.35144</td>
<td>0.39515</td>
<td>0.14367</td>
</tr>
<tr>
<td>RSAM</td>
<td>0.36758</td>
<td>0.34723</td>
<td>0.27815</td>
<td>0.06165</td>
<td>0.78103</td>
<td>0.57741</td>
<td>0.59279</td>
<td>0.44643</td>
<td>0.32100</td>
<td>0.26251</td>
<td>0.78103</td>
<td>0.57741</td>
<td>0.59279</td>
<td>0.44643</td>
<td>0.32100</td>
<td>0.26251</td>
</tr>
</tbody>
</table>
CONCLUSIONS

- Reproducibility is lower at the back and at the rib sites because of the lack of precise landmark in those sites.
- No relationship was found between ultrasound indicators and BCS in beef cows.
- Measures of fat and muscle by ultrasonography at the lumbar is a very promising indicator in dairy cows.
- Measures at the buttock can be used as a complement in dairy cows.
- Ultrasonography is an easy and non-invasive way to determine body composition in dairy cows.
THANK YOU!

- UE1297 PAO : E. Briant, C. Mouazé, A. Touchard, N. Müller
- UE1414 H : D. Egal
- UE0326 DEP : D. Dozias, J. Moreau, E. Cobo, Y. Carbonnier, S. Leurent-Colette, G. Kohn
- UMR0085 PRC : J-L. Touzé
- UMR1213 UMRH : J-M. Giraud, A. de la Torre, J. Agabriel
- UMR1313 GABI : G. Renand