Profiling the meat quality of blue wildebeest

(Connochaetes taurinus)

A VAN HEERDEN & PROF. LC HOFFMAN
Africa needs to double food production in next 35 years

- Meat – essential nutrients
- Exchange rates
- Need to identify local protein sources - avoid economic insecurity

(Aisbey, 1974; Dry, 2012; Torry, 2015)
SOLUTION = Game farming

- Animal protein – animal numbers
- Game animals better adapted

Strategically and sustainability utilise hospitable scrub into food and energy

Industry growth
- Development of various combinations of production systems
- Optimise animal production
- Need – balance breeding and meat production
- Avoid pressure placed on natural resources

Opportunity to expand commercialisation of game meat production

(Berry, 1986; Barnes, 1998; Cloete, Van Der Merwe & Saayman, 2015; Taylor, Lindsey & Davies-Mostert, 2016; Janvosky, 2016)
Blue wildebeest

- Reared semi-extensively & extensively
- Hardy, highly adaptable, fertile & resistant to most tropical diseases
- Widely distributed
- One of the most preferred hunting species

**LITTLE ATTENTION AS A MEAT PRODUCER**

(Furstenburg, 2002; Bothma, 2013)
• Primary aim of farming wildebeest
• High quality animals for live sales, trophy hunting
  • Breeding of the golden wildebeest
  • Numbers have grown
  • Animals not meeting criteria (Split F1, inferior horns) = available for meat production

(Furstenburg, 2002; Bothma, 2013)
• Ideal species – MEAT PRODUCTION
• High animal production turnover
• Alternative methods to utilise surplus and sub-standard stock – especially bulls
• Maintain an unspoilt habitat & financial viability of farm

(Vestergaard et al., 2000)
Can it compete with available products?

NEED: meat production potential, quality and nutritive properties.

Limited information available.

Intrinsic factors – Species specific research required

Does production system have an influence?

No information

Extrinsic factors affect the carcass = differences in meat quality

(Kohn et al., 2005)
AIM

Carcass characteristics
Physical parameters

Optimum aging period
Sensory profile
Chemical composition

• Production system
• Age
• Muscle type
METHODOLOGY

SLAUGHTER
- Carcass weights
- Removal of offal & muscles

PHYSICAL ANALYSIS
- Meat colour
- Moisture loss
- Tenderness

CHEMICAL ANALYSIS
- Moisture
- Protein
- Fat (IMF)
- Ash (inorganic)
- Fatty acids

SENSORY ANALYSIS
- Aroma
- Flavour
- Texture

AGING
- Optimum time

Extensive production system
8 bulls

Semi-extensive production system
8 bulls

(Van Schalkwyk & Hoffman, 2016)
### CARCASS YIELDS

#### Carcass Weight (kg)

<table>
<thead>
<tr>
<th>Extensive</th>
<th>Semi-extensive</th>
<th>Adult</th>
<th>Sub-adult</th>
</tr>
</thead>
<tbody>
<tr>
<td>168.8</td>
<td>208.2</td>
<td>211.15</td>
<td>111.3</td>
</tr>
<tr>
<td>84.9</td>
<td>112.1</td>
<td>85.7</td>
<td>50.2</td>
</tr>
<tr>
<td>52.6</td>
<td>53.8</td>
<td>51.5</td>
<td></td>
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</tbody>
</table>

#### Dressing Percentage

- 50.2%
- 53.8%
- 51.5%

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**Legend:**
- Extensive
- Semi-extensive
- Adult
- Sub-adult
Carcass Yields

High value cuts

<table>
<thead>
<tr>
<th>Muscle type</th>
<th>Extensive</th>
<th>Semi-extensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTL</td>
<td>4.08ª</td>
<td>4.06ᵇ</td>
</tr>
<tr>
<td>BF</td>
<td>5.55ᵇ</td>
<td>5.06ᵃ</td>
</tr>
<tr>
<td>SM</td>
<td>4.06ᵇ</td>
<td>4.31ᵃ</td>
</tr>
<tr>
<td>ST</td>
<td>3.14ᵇ</td>
<td>1.28ᵇ</td>
</tr>
<tr>
<td>IS</td>
<td>1.22</td>
<td>1.48</td>
</tr>
<tr>
<td>SS</td>
<td>1.65ᵃ</td>
<td>1.23</td>
</tr>
</tbody>
</table>

Muscle type: LTL, BF, SM, ST, IS, SS

Extensive, Semi-extensive

Graph showing weight (kg) distribution across different muscle types.
Visual appearance → PHYSICAL QUALITY → In-mouth texture

(Honikel 1998)
Effect of production system

- Extensive: 1.5
- Semi-extensive: 1.3
### Effect of age: Adult vs Sub-adult

<table>
<thead>
<tr>
<th>Physical Parameter</th>
<th>Age</th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adult</td>
<td>Sub-adult</td>
<td></td>
</tr>
<tr>
<td>Cooking loss (%)</td>
<td>37.6 ± 0.63</td>
<td>35.5 ± 0.63</td>
<td></td>
</tr>
<tr>
<td>Shear force (N)</td>
<td>35.7 ± 1.28</td>
<td>31.8 ± 1.34</td>
<td></td>
</tr>
</tbody>
</table>
### PHYSICAL QUALITY

- **Effect of muscle type**
  - **pH** = 5.3 – 5.8
  - Low drip loss
  - Lower cooking loss = enhanced juiciness
  - Tender < 43 N
  - Tough > 53 N

<table>
<thead>
<tr>
<th>Physical parameter</th>
<th>Muscle type</th>
<th>LTL</th>
<th>BF</th>
<th>SM</th>
<th>ST</th>
<th>IS</th>
<th>SS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hindquarter</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>pH&lt;sub&gt;U&lt;/sub&gt;</td>
<td></td>
<td>5.7&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>5.6&lt;sup&gt;c&lt;/sup&gt;</td>
<td>5.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.8&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td>Drip loss (%)</td>
<td></td>
<td>1.6&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>1.4&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>1.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.4&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>1.0&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1.2&lt;sup&gt;cd&lt;/sup&gt;</td>
</tr>
<tr>
<td>Cooking loss (%)</td>
<td></td>
<td>34.6&lt;sup&gt;c&lt;/sup&gt;</td>
<td>37.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>38.8&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>40.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>30.8&lt;sup&gt;d&lt;/sup&gt;</td>
<td>37.6&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Shear force (N)</td>
<td></td>
<td>37.8&lt;sup&gt;b&lt;/sup&gt;</td>
<td>39.5&lt;sup&gt;b&lt;/sup&gt;</td>
<td>43.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>33.3&lt;sup&gt;c&lt;/sup&gt;</td>
<td>24.1&lt;sup&gt;d&lt;/sup&gt;</td>
<td>24.4&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
### Effect of muscle type

- **L* < 40**
- **High a***
- **Low b***

### Attractive colour

<table>
<thead>
<tr>
<th>Colour</th>
<th>Muscle type</th>
<th>Hindquarter</th>
<th>Forequarter</th>
</tr>
</thead>
<tbody>
<tr>
<td>L*</td>
<td>LTL</td>
<td>33.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>33.7&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>BF</td>
<td>30.6&lt;sup&gt;c&lt;/sup&gt;</td>
<td>33.0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>SM</td>
<td>33.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>31.9&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>ST</td>
<td>31.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>33.7&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>IS</td>
<td>31.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>33.0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>SS</td>
<td>33.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>33.0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>a*</td>
<td>LTL</td>
<td>12.1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>10.9&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>BF</td>
<td>11.3&lt;sup&gt;c&lt;/sup&gt;</td>
<td>14.8&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>SM</td>
<td>11.7&lt;sup&gt;bc&lt;/sup&gt;</td>
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<td>ST</td>
<td>10.9&lt;sup&gt;d&lt;/sup&gt;</td>
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<td></td>
<td>IS</td>
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<td>15.1&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td></td>
<td>SS</td>
<td>15.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15.1&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>b*</td>
<td>LTL</td>
<td>7.3&lt;sup&gt;d&lt;/sup&gt;</td>
<td>9.4&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td></td>
<td>BF</td>
<td>7.8&lt;sup&gt;c&lt;/sup&gt;</td>
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<td>9.4&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td></td>
<td>IS</td>
<td>8.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>8.5&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

**Bright red colour meat**
CHEMICAL COMPOSITION

BASIC CHEMICAL COMPOSITION OF MEAT

- PROTEIN
- FAT
- WATER
- ASH – INORGANIC RESIDUES

### CHEMICAL COMPOSITION

- **Effect of production system**
- **Consumer preference**
  - High protein
  - Low IMF

<table>
<thead>
<tr>
<th>Chemical Parameter</th>
<th>Production system</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Extensive</td>
</tr>
<tr>
<td>Moisture</td>
<td>77.5 ± 0.19</td>
</tr>
<tr>
<td>Protein</td>
<td>20.5 ± 0.23</td>
</tr>
<tr>
<td>IMF</td>
<td>1.8 ± 0.08</td>
</tr>
<tr>
<td>Ash</td>
<td>1.01 ± 0.01</td>
</tr>
</tbody>
</table>

IMF – intramuscular fat
Effect of muscle type

<table>
<thead>
<tr>
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<th>LTL</th>
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<th>SM</th>
<th>ST</th>
<th>IS</th>
<th>SS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>75.9&lt;sup&gt;d&lt;/sup&gt;</td>
<td>76.5&lt;sup&gt;cd&lt;/sup&gt;</td>
<td>76.0&lt;sup&gt;d&lt;/sup&gt;</td>
<td>77.2&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>77.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>78.5&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Protein</td>
<td>22.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>21.4&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>22.2&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>21.0&lt;sup&gt;c&lt;/sup&gt;</td>
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<td>19.3&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
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<td>IMF</td>
<td>1.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.8&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>1.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.9&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>Ash</td>
<td>1.0&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.1&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>1.1&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>1.0&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>1.0&lt;sup&gt;abc&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Blue wildebeest meat = lean
- High in protein ~ 21g per 100g
- Low in IMF ~ 1.7g per 100g
### Effect of muscle type

<table>
<thead>
<tr>
<th>Chemical Parameter</th>
<th>Muscle type</th>
<th>LTL</th>
<th>BF</th>
<th>SM</th>
<th>ST</th>
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<tr>
<td>Moisture</td>
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<td>75.9&lt;sup&gt;d&lt;/sup&gt;</td>
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<td>1.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.6&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>Ash</td>
<td></td>
<td>1.0&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.1&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>1.1&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

#### High value cuts

- **Round**
  - LTL
  - BF
  - SM
  - ST

- **Loin**
  - LTL

[Diagram of muscle cuts]
SENSORY ANALYSIS

Aroma & flavour
- Beef-like
- Sweet-oily

Aroma & flavour
- Gamey
- Metallic
- Liver-like

(Oltra et al., 2015)
Effect of production system

- 13 meat sensory experienced judges
- Flavour, aroma and eating quality

<table>
<thead>
<tr>
<th>Aroma and flavour</th>
<th>Extensive</th>
<th>Semi-extensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall meat aroma</td>
<td>69.9 ± 0.58</td>
<td>72.1 ± 0.49</td>
</tr>
<tr>
<td>Sweet oily aroma</td>
<td>13.2 ± 0.36</td>
<td>14.2 ± 0.26</td>
</tr>
</tbody>
</table>

More desirable
# SENSORY ANALYSIS

## Blue wildebeest meat

<table>
<thead>
<tr>
<th></th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall meat aroma</td>
<td>~70</td>
</tr>
<tr>
<td>Gamey aroma</td>
<td>~66</td>
</tr>
<tr>
<td>Beef-like aroma</td>
<td>~62</td>
</tr>
<tr>
<td>Overall meat flavour</td>
<td>~70</td>
</tr>
<tr>
<td>Gamey flavour</td>
<td>~63</td>
</tr>
<tr>
<td>Beef-like flavour</td>
<td>~63</td>
</tr>
<tr>
<td>Liver-like aroma</td>
<td>zero</td>
</tr>
<tr>
<td>Liver-like flavour</td>
<td>zero</td>
</tr>
</tbody>
</table>

Gamey is negative.
### SENSORY ANALYSIS

**Blue wildebeest meat**

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<tr>
<td>Liver-like aroma</td>
<td>zero</td>
</tr>
<tr>
<td>Liver-like flavour</td>
<td>zero</td>
</tr>
</tbody>
</table>

Positive
SENSORY ANALYSIS

Fatty acids

• SFA levels
• Low PUFA
• PUFA:SFA ratio
• Omega-6:Omega 3 ratio

Flavour

Health

Consumers demanding correct fatty acid profile

Fat/lipids
- SFA levels
- Low PUFA
- PUFA:SFA ratio
- Omega-6 : Omega 3 ratio

**Overall a good fatty acid profile**
AGING ANALYSIS

Semi-extensive production system
bulls
28 months old

Round
Loin

AGING

• Period
• Physical quality

Aging days: 2, 5, 9, 14, 21, 28 at 4°C

Physical analysis

(R) Loin
(L) Loin
(R) BF
(L) BF

(Van Schalkwyk & Hoffman, 2016; Honikel, 1998)
Optimum ageing periods = Loin 9 days PM & Round 14 days PM
Colour during aging

- Consumer acceptance - L* < 40, high a*, low b*
- Less yellow/brown than beef at optimum aging period

Negative >4%
Animals produced in semi-extensive system:
- better meat production potential
- Higher value
- Higher meat protein content
Sub-adult bulls exhibited the more desirable characteristics – lower cooking loss and tenderness
Muscle type influence all physical quality parameters

Consumer desired sensory profile
- Good fatty acid profile – lean and healthy (positive)
- Loin reached optimum tenderness as early as day 9 PM
- BF reached lowest tenderness day 14 PM
This period was associated with favourable purge loss, cooking loss and colour
OVERALL CONCLUSION

Blue wildebeest meat

LEAN, HEALTHY, TENDER & TASTEFUL
RECOMMENDATIONS

- Study was limited to only bulls
- Future studies should include:
  - Intrinsic factors (gender)
  - Extrinsic factors (season, intensive production system, vegetation)
  - Fibre types – variation in muscles
- Safety – microbial analysis
- Growth parameters to determine optimum weight/age to slaughter
- Identify target market
- Numbers of blue wildebeest farmed – availability
- Economic feasibility
- Feed cost vs meat sold
ACKNOWLEDGEMENTS

- For their advice, support & assistance
  - Professor L.C Hoffman
  - Mr Barry and Richard York of York Safaris for the donation of the research animals
  - Mr Pierre Cremer of Bushlovers Lodge Farm
  - Stellenbosch University personnel

- For their financial support
  - NRF/SARChI Chair
QUESTIONS?