The Dry Aging of Beef – a Review

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I. INTRODUCTION

There is a certain risk of producing unsafe or low quality dry aged beef caused by natural variations, such as initial microbial status and/or meat quality due to a lack of knowledge in regard to process conditions (time, temperature, relative humidity, etc.). This demonstrates the importance of research activities on the dry ripening process. Hence, based on a research project (CORNET AiF 162 EN) an intensive literature review of approx. 230 studies regarding evaluation of raw material, equipment design, sensory tests according to dry aged beef attributes and special analysis was carried out. 22 studies have dealt directly with the dry aging of beef. Therefrom 16 studies are from 2008 – 2018 which underpins the increasing interest in this technology. The total literature review is planned to be shown via an oral presentation at ICoMST 2018, while this short paper focuses on the evaluation of texture and flavour of dry aged beef.

II. MATERIALS AND METHODS

Raw material
Angus beef was utilized three times [1-3], Swedish red twice [4, 5], Holstein [6], Swedish Holstein [4] and Hereford [7] once. In the other 15 studies the breed was not described. In 14 of 22 studies the gender was not mentioned, whereas some scientists considered gender to be more important for tenderness than breed [8]. Heifer [5, 7, 9], steer [5, 8, 10] and cow [6, 8, 11] were used in three studies respectively, and bull once [4]. Often in literature applied cuts are shown in Tab. 1.

Ripening method
Mostly, wet aging was compared to dry aging but comparison was also conducted with in-the bag dry aging to traditional dry [1, 12] or wet aging [7, 8]. In addition, all three ripening methods have been compared [4, 5, 13, 14].

Ripening parameters
Maximal duration of dry aging varied from 14 [7] to 49 days [15], ripening temperature from -0.6 [16] to 4 °C [11, 17] and applied relative humidity from 49 [10] to 98 % [17].

Analysis
In 20 studies scientists deployed consumer and/or trained panellists for analysing sensory tenderness and flavour components for comparison with respective analyses (Tab. 1). For texture analyses Warner Bratzler shear force (WBSF) was determined due to AMSA-guidelines [18] with devices of Instron [1-3, 6, 9, 13], Universal Material Testing [11, 12, 16, 19, 20], Stable Micro Systems [7, 8] or G-R Electrical Manufacturing [15]. A MIRINZ tenderometer was also utilized [10]**.** Flavour analyses were conducted by Kim *et al.* [10] due to a metabolite analysis via NMR spectroscopy and by Pietro *et al.* [8] via thermal desorption-gas chromatography-mass spectrometry (TD-GC-MS).

III. RESULTS AND DISCUSSION

Raw material, i. e. breed, gender, age as well as utilised **ripening method** varied strongly. **Ripening parameters** were set as constant, except for Kim *et al.* [10]. The average temperature in the reviewed literature was 2 °C, relative humidity was 75 to 80 % and ripening time was 28 days.

Analysis
Laster [19], in contrast to Campbell *et al.* [2], figured out that wet aged beef has lower WBSF than dry aged beef (DAB). In other studies no differences between aging treatments were observed. Equal treatment of different muscles resulted in variation of WBSF and therefor sensory tenderness. Thus, WBSF variation is muscle-dependent [16, 19]. Resulting from sensory tests, tenderness evaluated by panellists gave more differences between aging treatments than texture analysis (Tab. 1). In five out of 20 studies DAB was

tenderer, whereas in 12 studies no significant differences were found. In ten cases, DAB flavour components were described as more beefy, brown/roasted, salty or flavourful regarding umami or aging attributes. According to Kim *et al.* [10] eight metabolites differ between dry and wet aged beef. Tryptophan, Phenylalanine**,** Valine, Tyrosine, Glutamate, Isoleucine and Leucine are more abundant in DAB. This is resulting in another, more savoury/beefy and umami, flavour profile. Prieto *et al.* [8] identified 95 flavour compounds via TD-GC-MS in cow and steer. Comparison of wet and dry aged steer beef revealed a decrease in undesirable flavour components in DAB.

Table 1: Overview of utilized muscle cuts and amount and kind of panellists as well as their rating for tenderness and flavour (n. d. means no difference). Dry aged beef (DAB) is rated higher (↑) or lower (↓) to the compared ripening method.

Cut	Sensory			Ref.
Muscles name	Amount and kind of panellists	Result for tenderness	Result for flavour	No.
Longissimus lumborum, longissimus thoracis, gluteus medius	80 consumer	DAB ↓	n. d.	[19]
	261 consumer	n. d.	n. d.	[16]
Longissimus thoracis et lumborum	171 and 61 consumers	DAB ↑	DAB ↑	[4]
	10 trained and 264 consumer	DAB ↑	DAB ↑: umami flavour	[5]
Longissimus lumborum	120 consumer	n. d.	DAB ↑: flavourful	[10]
	6 trained	DAB ↑	DAB ↑: beefy, brown/roasted	[2]
	6 trained	n. d.	n. d.	[13]
	8 trained	n. d.	DAB ↑: aged flavour	[15]
	8 trained	n. d.	DAB↓: more off flavour	[6]
	8 trained	n. d.	DAB ↑: more salty	[8]
Longissimus dorsi	Not conducted			[11]
	77 consumer	n. d.	n. d.	[20]
	trained	n. d.	n. d.	[9]
Logissimus dorsi, gluteus medius	27 – 33 consumer	DAB ↑	n. d.	[14]
Gluteus medius	129 consumer	DAB ↑	DAB ↑	[7]
Gluteus medius, longissimus thoracis	107 consumer	n. d.	DAB ↑: beefy, brown/roasted	[17]
Longissimus	273 consumer	DAB ↓	n. d.	[3]
Cutanous omo-brachialis and brisket	Not conducted			[21]
Strip loin	6 trained	n. d.	DAB ↑: aged flavour	[1]
	5 trained	n. d.	DAB ↑: beefy, brown/roasted	[22]
Strip and shell loin	6 trained	n. d.	n. d.	[12]
Strip loin and rib	10 trained	DAB ↓	n. d.	[23]

IV. CONCLUSION

Reviewed literature illustrates that low WBSF-values cause a higher rating for tenderness. In case of common aged beef, tenderness is analysed by the calpastatin activity [24] or measured via near infrared spectroscopy etc. [25]. Those methods could be an opportunity for determining tenderness of DAB.
Moreover, changes in abundant metabolites could be seen as flavour enhancement of DAB. Based on limited literature dealing with the dry aging process and high variations in natural materials, it is not possible to draw a general conclusion. Besides the improvement in tenderness, dry aging definitely contributes to a different flavour profile of beef, which can be pleased by consumer, who are used to DAB [16, 19, 20]. Maximal or rather necessary duration of aging, temperature, relative humidity as well as microbial results and other evaluations remain unconsidered in this context.

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REFERENCES

The list of references is available by the corresponding author.