Facilities and research at Department "Cattle fattening and meat quality"

Dr. Margit Velik
Presentation "Department Cattle Fattening and Meat Quality"
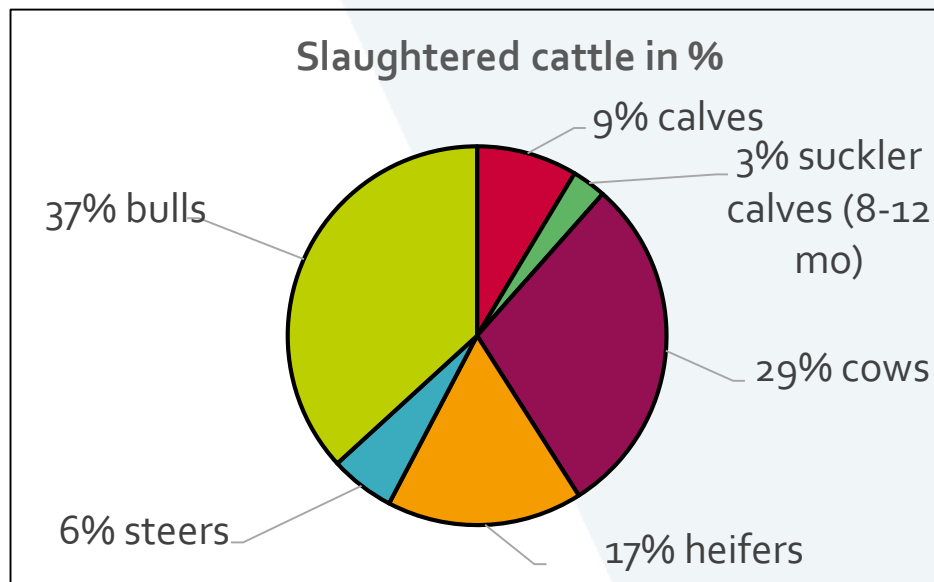10th Juni 2022 – Study Visit Agricultural Research Center Rapotin (Czech Republic)

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Overview

- **Beef production in Austria**

- **Research fields** of the Department

- **Facilities** of the Department

- Finished **research project: Beef marbling**

- 2 **current research projects**

- **→ Visiting 2 current fattening trials outdoor**

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Beef production in Austria

- Approx. 650.000 slaughtered cattle per year

- Beef self supply : 145%

- Meat consumption per head: 60,5 kg (11 kg beef)

- Austrian breeds: 75% Fleckvieh (Simmental), 7% Holstein, 6% Brown Swiss

  – For beef fattening: Fleckvieh, Fleckvieh×beef breed

  – Hardly dairy breeds in beef fattening (except calf production)

- Various labels for all 5 beef categories (higher price for carcasses)

Slaughtered cattle in %

9% calves

3% suckler calves (8-12 mo)

37% bulls

29% cows

6% steers

17% heifers

Source: Statistik Austria, AMA, Grüner Bericht

Styria Beef

RINDFLEISCH à la carte

CULT BEEF KALBIN SELECT

Almo

premium RIND Jahrling

alpenvorland RIND

ja! Natürlich.

M-RIND

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My research fields

- **Feeding, growth and fattening performance, carcass and meat quality of**
  - bulls
  - steers
  - heifers
  - suckler calves from suckler cows
  - calves

- **Intensive and extensive production systems**

- **Main focus on effects of nutrition, feeding and breed**

- Fatty acids in cow milk of different production systems

Facility: Barn for cattle fattening

- Loose-barn with straw bedding for 20 animals (4 boxes)
 - 2 boxes with outdoor access
- Calan Gates for individual feeding

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Facility: Barn suckler cows and suckler calf production

- Contact person: **Hans Häusler**

- Loose-barn with straw bedding for 32 animals (16 suckler cows, 16 suckler calves) with outdoor access

- Currently in this barn feeding trial: Grassland fattening of crossbred Holstein×Angus

  – Project details later

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Data collection and data analyses in experimental trials

- **Fattening performance** (weight once per week and daily gains, feed analyses, daily feed and nutrient intake, feed efficiency during fattening)

- **Carcass quality** (fat and carcass conformation, weight of cuts and organs, fat deposition, …)

- **Meat quality** (M. longissiums and M. semitendinosus, different ageing periods)
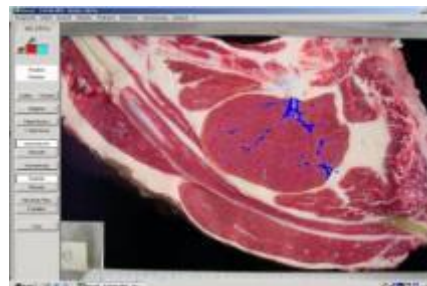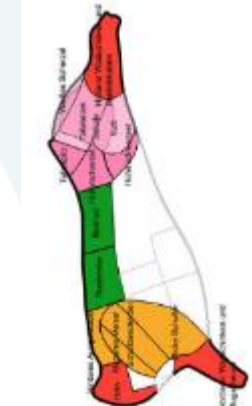
Facility: Slaughter house

Facility: Meat laboratory

- Contact person: Ing. **Roland Kitzer**

- **Analyses**
  - Meat and fat colour
  - Water holding capacity (drip, grill, cooking loos)
  - Shear force, longissimus area (cm^2),
  - (Untrained) consumer panel
  - Meat composition (TM, CP, CA, IMF, fatty acids, minerals) -> (Lab in other buildung)
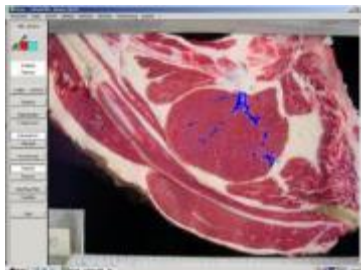
Meat lab at 11:00 a.m. with Roland Kitzer

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On farm experiments

- **Cooperation with agricultural high schools**

- Traits: Nutrient composition of feedstuffs, daily gains, carcass and meat quality
  - Grassland based suckler calves from different breeds (Limousin, Fleckvieh×Limousin, Angus, Angus×Fleckvieh)
  - Bulls, steers and heifers (system approach) (Fleckvieh)
  - Fleckvieh×Wagyu and Charolais×Wagyu steers and heifers

- **Cooperations with farms**
  - Fleckvieh vs. Brown Swiss bulls in an intensive fattening system

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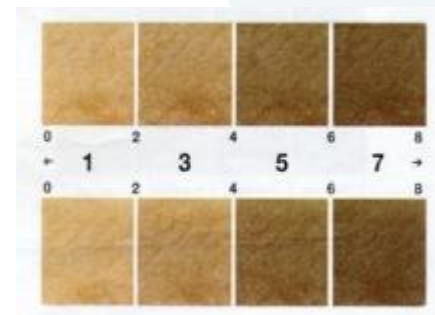Landwirtschaft

Examination of data sets

- Carcass quality of beef cattle after alpine pasture (impact of slaughter date after pasture and breed)

- Steer beef label **Almo**: carcass quality of steers fed with a pasture period and indoor finishing

- Meat colour of veal from organic production systems (milk fed, 4 months old)

Finished research projects (experimental trials)

- Fattening heifers (1) on continuous grazing with indoor finishing or (2) in barn in mountainous regions

- Bull fattening to different live weights with different protein levels in the finishing period

- Dairy calves (3 Holstein genotypes and Brown Swiss) vs. Fleckvieh in bull fattening systems

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Beef Marbling:
Association with
carcass traits
and beef tenderness

Dr. Margit Velik
Finished research project
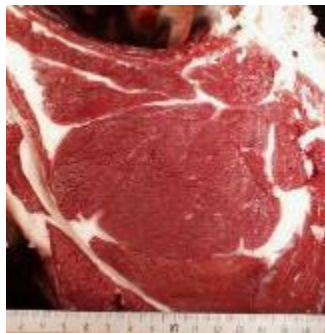
Introduction (1)

- Carcasses should be well muscled with moderate fat cover

    – Aim of carcass classification:

    conformation E, U, R

    fatness score 2, 3, (4)

- Growing animals

    – First growth of bones, second muscle growth, finally fat tissue

        - In breeds with high muscle growth potential, development of fat tissue starts late(r)

    Source: Augustini 1987, Wegner et al. 1998, Warriss 2000, Pethick 2006

Introduction (2)

- 4 major fat depots
  - (1) intestinal fat (kidney fat, …)
  - (2) intermuscular fat (between muscles)
  - (3) subcutane fat (fat cover)
  - **(4) intramuscular fat (IMF) = marbling**
    - Important for palatability, tenderness, juiciness

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Introduction (3)

- **Internationally beef marbling is important** (USA, Australien, Japan, …)
  - Consumers prefer higher marbled beef
- In **Europa** beef marbling **not recorded / paid for**
- Steakhouses, top gastronomy, grill events … buy and sell well marbled beef from oversea
- In Austria few beef labels (e.g. _www.cult.beef_), butchers and direct marketing advertise with marbling

Fat in human nutrition often negative image; nevertheless demand for well marbled beef ->marketing -> **additional value for farmers, butchers, meat trade, gastronomy**

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Influence factors an IMF / marbling

- **Animal specific**

  – Sex, category

  – Breed, genetics

- **Production specific**

  – Final live weight, slaughter age

  – Management, housing

  – Feeding (intensity), backgrounding

  – Feeding regime *(Park et al. 2018)*

    - Forage and concentrates (ratio, components, …)

    - …

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Animals, materials und methods (1)

- **Purpose of the project: investigation of relationships between IMF/marbling and carcass traits as well as meat tenderness**

- **14 Austrian beef fattening trials** (bull, heifer, steer)
  - Approx. 800 data sets
    - 63% bulls, 20% heifers, 17% steers
    - Typically Austrian feeding rations and slaughter age/weight
    - Breeds: Fleckvieh and Fleckvieh-crosses; some Wagyu-crosses, Angus, domestic breeds (Pinzgauer, Grauvieh)
  - Data on carcass traits and beef tenderness (shear force, panel)
    - IMF (Soxhlet, NIRS) of forerib (*M. long. dorsi*)
    - Meat 14 days aged

Animals, materials and methods (2)

- **Statistical analyses**

  – **(1) Covariance analysis** (**11 feeding trials** and 500 data sets): **Effect of slaughter performance** on **IMF**

  – **(2) Correlations** (Pearson, Spearman), **scatterplots** (14 trials and 800 data sets): **relationship tenderness and IMF**

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Research question (1)

- What effect have beef category, breed, slaughter age, slaughter weight and carcass fatness on IMF content?

Database 11 fattening trials (covariance analysis)

Trait	Unit	Bull		Steer		Heifer	
		mean	σ	mean	σ	mean	σ
Number animals		314		73		128	
Slaughter age	Tage	534	49	636	68	508	58
Final live weight	kg	675	31	635	29	539	19
Carcass weight (cw)	kg	391	21	348	22	300	20
Dressing percentage	%	58.0	2.0	55.5	2.0	56,1	2,1
Daily gains	g	1,284	128	1,069	102	1,132	92
Daily net gain	g	742	71	592	59	607	64
Carcass conformation	Pkt 1-5 (5=E)	3.81	0.54	3.33	0.52	3.67	0.44
Fat class	Pkt 1-5 (5=fett)	2.34	0.41	2.80	0.56	2.97	0.57
pH, 48 h p.m.		5.60	0.20	5.56	0.14	5.61	0.12
Kidney fat	% v. cw	2.38	1.10	3.97	1.64	3.84	1.29
IMF-content (Soxhlet/NIRS)	mg/g FM	19	9	34	14	30	13

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Results – IMF und slaughter performance

- **Significant effects on IMF content according to model** (R^2=58%)

  - **Trial** (11 trials)

  - **Beef category** (bull, steer, heifer)

    - Bull lowest IMF content

  - **Slaughter age**

  - **Fatness class**

  - **Kidney fat**

> **No effect according to model**:
>
> - **Breed** (FV vs. FVxLI, FVxCH)
>
> - **Daily gains**
>
> - **Conformation class**

- Impact of **feeding/ energy supply** could **not** be **considered** in the model, because feeding trials too different -> feeding partly in effect „trial"

Results – IMF and slaughter age (1)

- **Slaughter age** has significant **effect** (P=0.012) **on IMF**

  - Impact in literature well documented *(Wegner et al. 1998, Branscheid et al. 2007, Park et al. 2018)*

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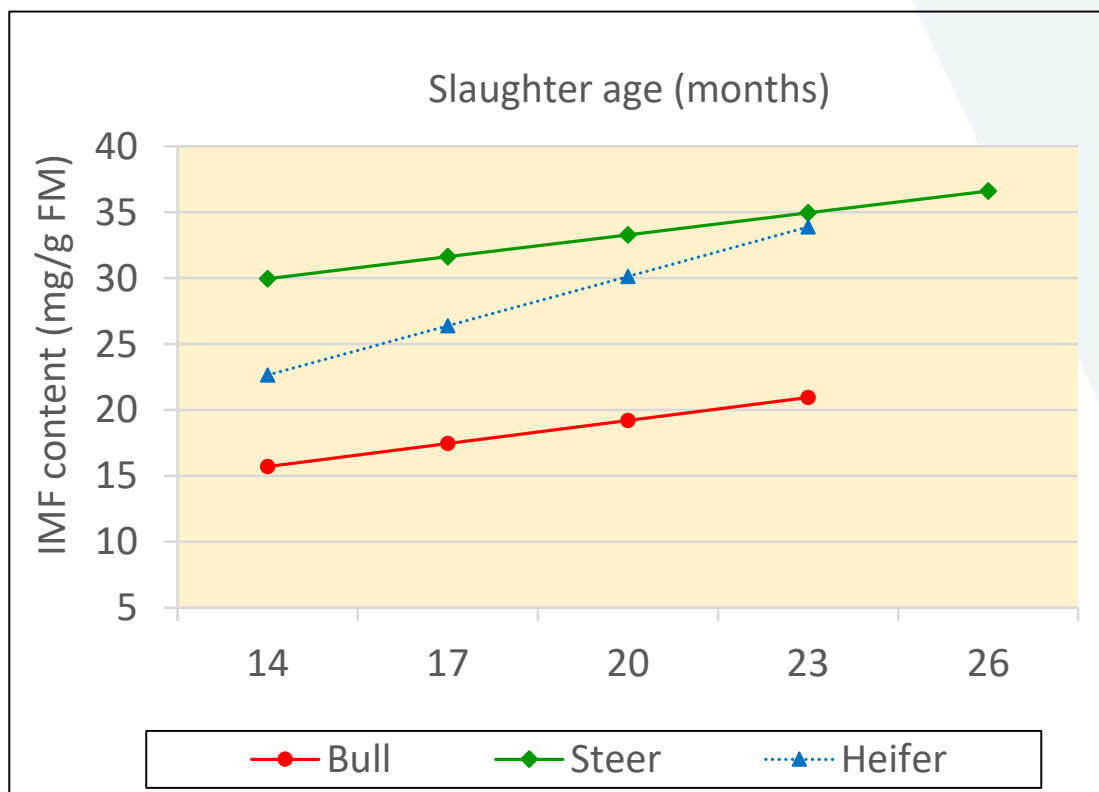
Results – IMF and slaughter age (2)

- **High slaughter age *per se* does not result in highly marbled beef**

- Necessary to put slaughter age **in connection with final live weight**
  - **Final live weight no significant effect in model**
  - However, if final slaughter weight instead of slaughter age in model, then significant (similar graph)

  Augustini u. Temisan (1986): Fattening intensity has stronger impact on carcass fatness then slaughter age

Results – IMF and fatness score

- **Fat cover score has** significant effect (P=0.001) on IMF
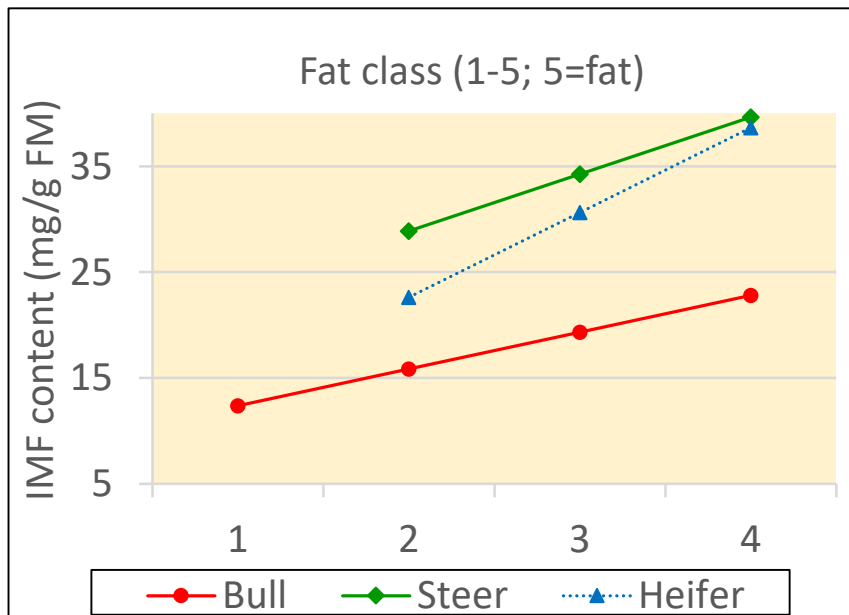
Correlation coefficient (r) = 0.18 (P<0.001) (single trials r= 0.20 – 0.74)

- Few literature, because fat class only in Europa: *Sanaa (2008)* und *Indurain (2009)* r=0.31 and 0.29, respectively

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Results – IMF and kidney fat

- **Kidney fat not routinely surveyed** in slaughter houses

- Significant correlation (P=0.005) between kidney fat and IMF

Kidney fat (% of carcass weight)

Legend: Bull, Steer, Heifer
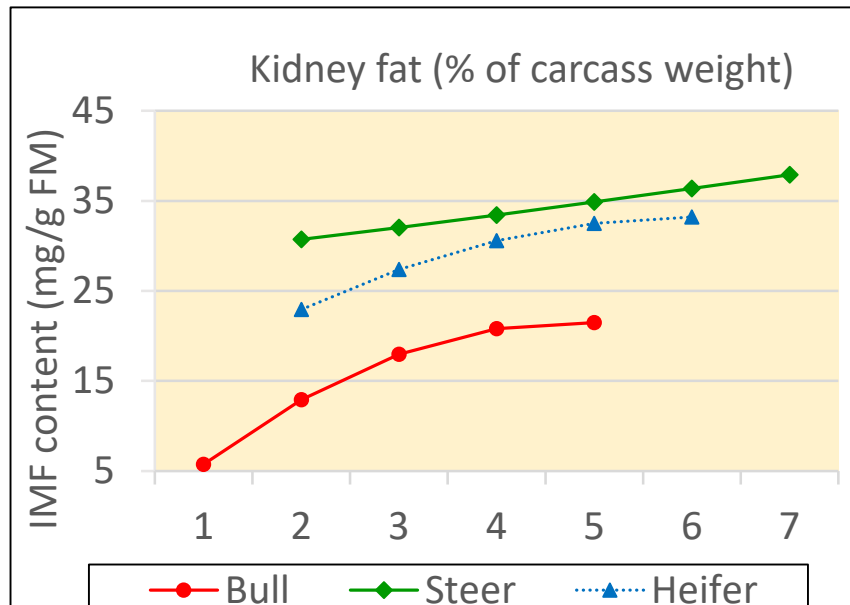
Correlation coefficients (r) = 0. 50 (P<0.001) (single trials r= 0.18 – 0.77)

- No literature found, which compares IMF and kidney fat

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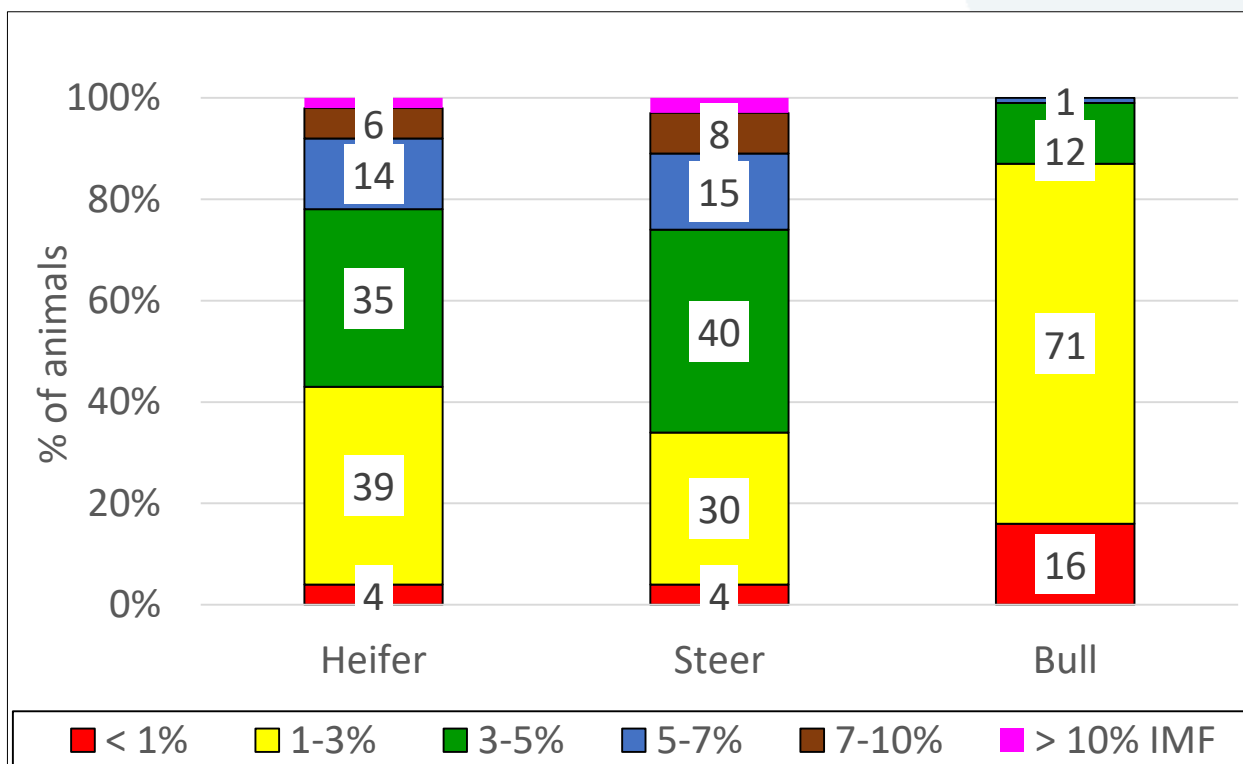Raumberg-Gumpenstein
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Research question (2)

- Is there a connection between IMF content and tenderness of Austrian beef?

- 14 trials with different designs (… Wagyu crosses, Grauvieh steers, Angus), 14 days meat ageing

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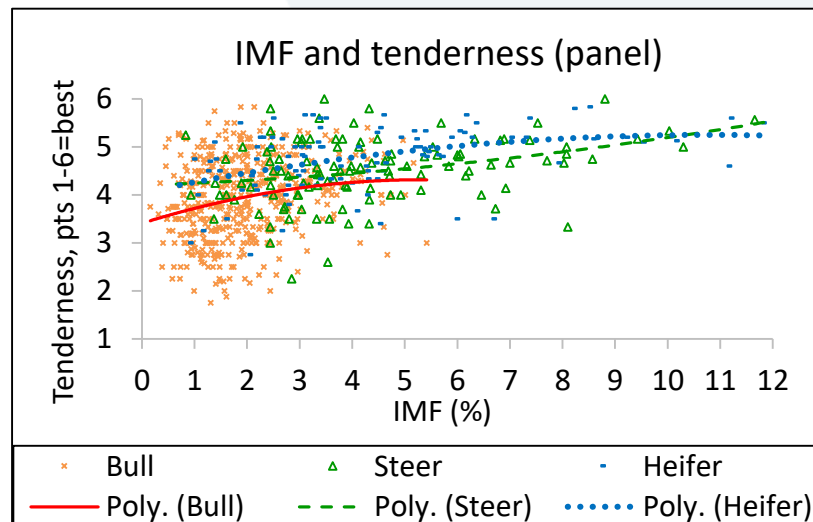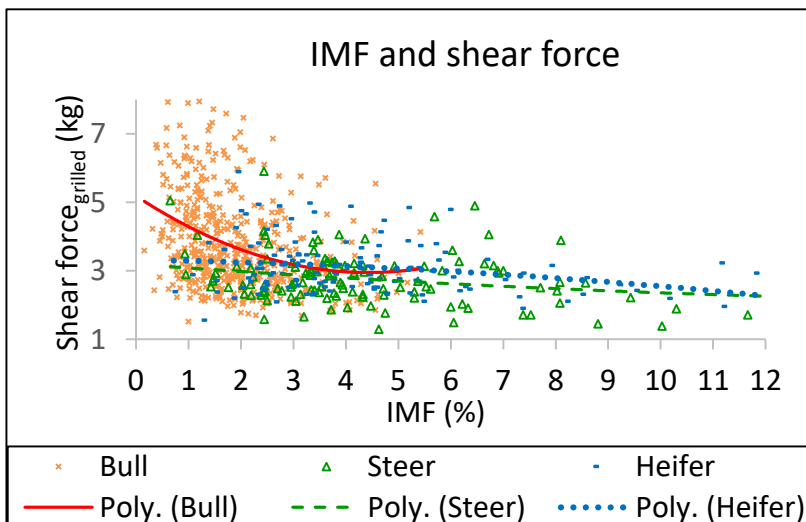Landwirtschaft

Results – IMF content of Austrian beef

Source: Velik 2020

*Data bases **14 fattening trials**: 161 heifers, 137 steers, 510 bulls*

IMF content accoring to Soxhlet / NIRS; forerib

Austrian beef has **Ø 2 - 4 % intramuscular fat (IMF) in the forerib**

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Results – IMF and shear force/tenderness

Correlation coefficients (r)

IMF and shear force: -0.23 (heifer), -0.24 (steer), -0.32 (bull) (P<0.05)

IMF and tenderness (panel): 0.41 (heifer), 0,33 (steer), 0,24 (bull) (P<0.05)
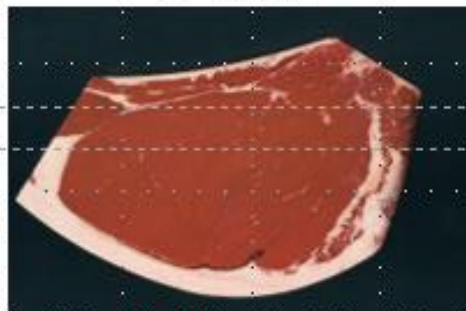
Further influence factors on beef tenderness: ageing, collagen content, muscle fibre type,...

....

Quelle Fotos: USDA 8843 (1981): Official USDA marbling photograph2. (gescannt: Velik)

Quelle IMF-Gehalte: 1998 - Beef Research Report – IOWA State University, A.S. Leaflet R 1529, (Wilson, D.E., Rouse, g.H., Greiner, S.)
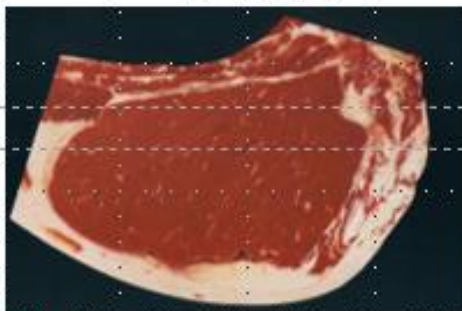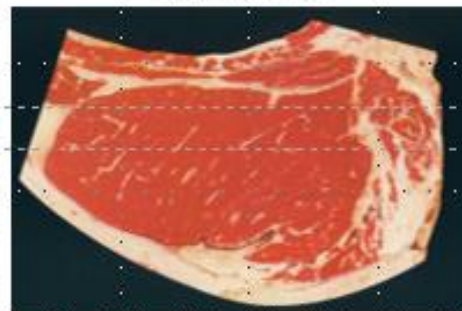
2,3 – 3,9 % IMF

4,0 – 5,7 % IMF

5,8 – 7,6 % IMF

*1,3 – 1,6 % IMF

*1,5 – 3,0 % IMF

*6,9 – 8,2 % IMF

7,7 – 9,7 % IMF

9,9 – 12,1 % IMF

> 12,3 % IMF

*8,4 – 10,9 % IMF
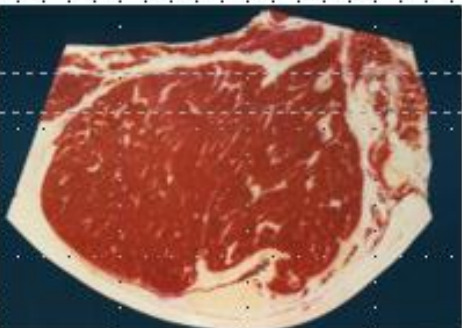
*10, – 14,3 % IMF
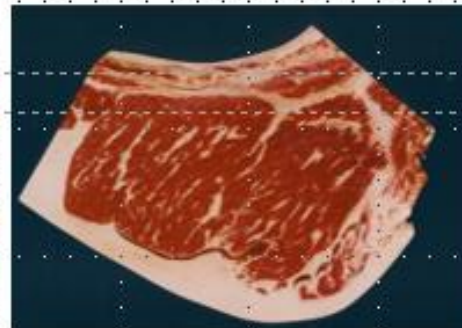
*18,4 – 22,0 %% IMF

*ILaut PicEd Cora (Fa. Jomesa), (Kitzer 2013)

Zusammengestellt: HBLFA Raumberg-Gumpenstein, Institut für Nutztierforschung

Research question (3)

- Are consumers able to assign beef sample photos to marbling classes (Verbal description of Ristic (1987) und example phots of Frickh et al. (2003)?

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Marbling classes of Ristic (1987) and marbling fotos of Frickh et al. (2003)

Pkte	Ausprägung	Beschreibung	IMF, %
1	keine sichtbare	blaues Fleisch	< 1
2	schwache	Existenz einiger sichtbarer Marmorierungspunkte	1-3
3	mittelmäßig	gut sichtbar eingelagertes Fett	3-5
4	stark	bereits dickere Fettfaszien	5-7
5	sehr stark	zahlreiche Fetteinlagerungen	7-10
6	zu stark	abnorme übermäßige Fetteinlagerung, Fettinfiltration	> 10

Fleisch-Marmorierung Rind
1 Punkt (< 1 % IMF)   2 Punkte (1-3 %)
3 Punkte (3-5 % IMF)   4 Punkte (5-7 %)
5 Punkte (7-10 % IMF)   6 Punkte (> 10 %)
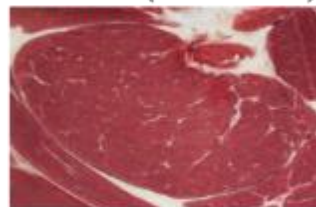
Quelle: FRICKH et al. 2003*

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Marbling classes and consumer assignment (1)

- Assessing marbling (35 meat fotos)

  - 11 persons of our institute with marbling cards of Frickh (2003) und table of Ristic (1987)

  - Before assessment: 30 minutes introduction in beef marbling evaluation

  - Gold standard = chemical IMF analyses (Soxhlet, NIRS)

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Result: Marbling and consumer evaluation

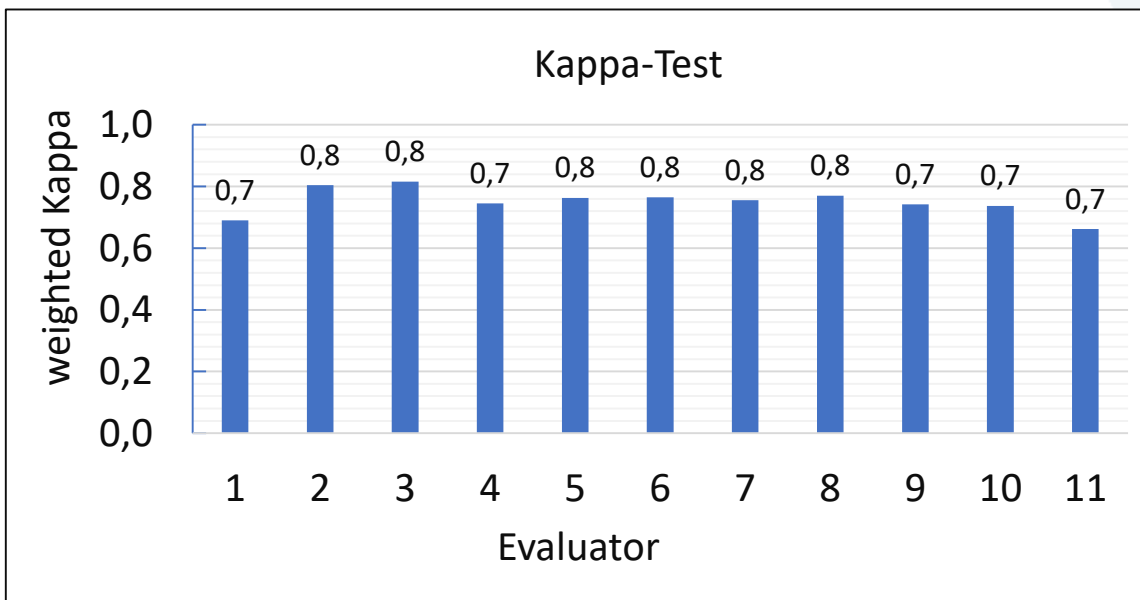– Photos Frickh et al. (2003b) together with description of Ristic (1987) e suitable for the assessment of marbling with little training.

– Degree of accordance: **Kappa-test between 0,75 and 0,93**

Kappa-Test

weighted Kappa (y-axis): 0,0 – 1,0
Evaluator (x-axis): 1–11
Values: 0,7 0,8 0,8 0,7 0,8 0,8 0,8 0,8 0,7 0,7 0,7

- Interpretation
  – > 0,8 very good accordance
  – > 0,6 good accordance

– Comment of evaluators: better marbling fotos for marbling class 2 and 6

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Conclusion (1)

- **Austrian beef** has **Ø 2 - 4 %** IMF in forerib

- **Analyses of Austrian beef fattening trials**

  - **Impact factors on IMF**: trial, beef category, slaughter age

    - *Final live weight, feeding intensity*

  - **Connection** between **IMF – fat class** and **IMF – kidney fat, respectively**

    - Single animal: party no correlation existent

  - **Marbling of forerib** (between forequarter and hindquarter) could be easly assessed with marbling cards

Conclusion (2)

- **Loose correlation** between **IMF** and t**enderness** of Austrian beef

- Besides marbling **more factors** must be optimised for a **convincing meat quality**

  - Beef category

  - Slaughter age, final live weight

  - Feeding intensity, backgrounding

  - Perimortal handling of slaughter animals and carcasses

  - Meat ageing

  - Preparation in the kitchen

  - ....

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- 2 **current research projects**

- ---> **Visiting 2 current fattening trials outdoor**

Grassland fattening
of crossbred dairy×beef breed
(Holstein×Angus)

Project duration: **2021 - 2024**

Introduction

- **Calves exports,** veal imports are strongly discussed in mass media and Austrian consumers

  – Dairy calves hardly any relevance for commercial bulls, steer and heifer fattening -> lower slaughter performance (daily gains, feed efficiency, conformation) compared to dual purpose breeds (Fleckvieh), and Fleckvieh crossed with beef breeds

- Search for opportunity, to increase domestic use of dairy calves

- **Possible solutions**

  – Domestic veal production

  – Spermasexing (female dairy cows)

  – Inseminatoin of dairy cows with beef breeds

  – ....

➡ **New research project of AREC Raumberg-Gumpenstein**

Experimental design

Location	Organic Institute	Insitute of Livestock Research
category	steers, heifers	
Breed/cross	Holstein×**Angus*** (bull: early maturing Angus) Fleckvieh-steers as controll group	
First 3 months	milk, hay, concentrates	
Feeding	grassland based	
	Continous grazing with supplements; After grazing period: hay-grass silage ad libitum, 1 kg EKF*	Hay-grass silage ration ≤280 kg LG: 1,5 kg EKF* >280 kg LG: 1 kg EKF
Final live weight	400 kg	

energy concentrate (maize, barley, wheat)

- ***Angus as beef breed**, because

  – early maturing, medium sized, robust

  – in extensive fattening systems convincing conformation and fatness class

  – Very good meat quality

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Why this project

- **Assessing the potential of a „grass cattle" from a dairy beed x beef breed regarding production system**

  – Intermediate product between suckler calves with suckler cow sytems and typical Austria steer and heifer fattening to higher slaughter weights and ages

- **Could be a further possibilty to**

  – Reduce exports of calves

  – Beef with very good feed efficiency and greenhaus gas emission

  – Beef fattening in grassland with very good product and process quality

Grassland based steer fattening with Fleckvieh and the domestic breed Pinzgauer regarding different feeding intensity

Project duration: **2022- 2026**

Introduction

- **Side adapted agricultre is a main topic in our institute**

  – Focus on domestic breeds

    - **Pinzgauer** (4th most common breed in Austria; 2 % of cattle)

- In Austria ca. 35.000 slaughtered steers per year -> **ca. 6 % of slaughtered cattle** *(Statistik Austria, 2021)*

  – In last dacade hardly any steer fattening trails in mid Europa

- In Austria steer fattening (slightly) decreasing in the last years

  – Several labels for meat of steers

  – Possibility to use grassland to get valuable food for humuns meat "

- Meat from steers very good product quality

Experimental design

Category	Steers	
Animals	40	
Breeds	FV	PI
2 fedding regimes	extensive vs. semi-intensive	
Initial live weight	Fresser 160-180 kg	
Final live weight	670 vs. 720 kg	

Feeding	extensive	semi-intensive
Bis 330 kg live weight	50 % GS*, 50 % hay (DM-basis), 1,5 kg KF*	
330 kg – finishing phase	75 % GS, 25 % hay	75 % GS, 25 % MS*, 2 kg EKF
Finishing phase (last 80 kg)	75 % GS, 25 % hay, 2 kg EKF	75 % GS, 25 % hay 2 kg EKF

GS…grass silage, mS…maize silage, KF…concentrates, EKF…energy concentrates

Thanks for your attention!

AREC Raumberg-Gumpenstein
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