Color classification of veal carcasses: Past, present and future

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From the farm to the table
Carcass classification

Veal carcasses are classified on

• Fatness (amount of fat tissue)
• Conformation (size and weight)
• Color

Color is an important factor for pricing

The color classification process is reviewed here
Past: visual classification

• Meat color was visually matched to a 10-point scale

• Scale design based on representative variations in meat color
Past: visual classification

- Visual task: determine the smallest difference

- Disadvantages:
  - Subjective
  - Dependent on illumination
Past: instrumental classification

Certified personnel perform on-line color measurements in the slaughterhouses.
Past: instrumental classification

- Handheld Minolta CR300 (tristimulus meter)
- Positioned on the *m. Rectus abdominis* (*vinkelap*)
- Measurement of CIE X,Y,Z
- 45 min post mortem
Past: instrumental classification

- Algorithm derived from database with both visual and instrumental measurements
- Discriminant analysis: calculates the most likely color class using functions based on measured $L^*$ and $a^*$ values

Measured CIE X, Y, Z

Conversion algorithm

Color class 1..10
Past: instrumental classification

> 80% within 1 color class difference
Present: update hardware & software

- Tristimulus meters replaced by newer version

Minolta CR300  Minolta CR400
Present: update hardware & software

• Improved calibration procedure (user calibration), using additional tile with representative target color
Present: update hardware & software
Present: update hardware & software

- New datasets:
  - instrumental only $n=113,556$
  - instrumental + visual $n=11,745$

Restricted area in CIELAB color space
Present: update hardware & software

• New algorithm to convert color measurement to a color class, based on $\Delta E_{94}$ color difference metric

• Finds minimum color distance to new, virtual color scale

![Diagram showing color classes and their corresponding ΔE values. The diagram includes a virtual color scale and a meat section with color differences indicated.]
Present: update hardware & software

- New algorithm is attuned to historical databases
Present: update hardware & software

- Good agreement with visual data

![Graph showing relative frequency of color classes with n=11745](image)
Main advantages $\Delta E$-based method

1. Works similar to visual classification: it determines the smallest difference to reference colors
2. Easy to explain and comprehend
3. Does not require complex statistical analysis
4. Less sensitive to small variations in color measurements
5. $\Delta E$ is an international / industrial standard
Future perspective

- LED illumination in color measurement equipment: longer life-time, less calibration efforts

- Operational research: local factors (temperature, humidity, animal stress, etc) affecting the color measurement?

- Camera based, non-contact color measurement
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