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Colour identification for assessment of quality in fresh potato products

Colours – even when open to individual interpretation – can generally be used as criteria in judging quality of fruit, vegetables and potatoes. There are no physical measurement parameters such as length or weight for determining colours. Developed, however, have been different possibilities of colour identification which can also be used with the above products. Reported here is the application of methods for colour identification with fresh potato products developed at the Institut für Agrartechnik, Bornim (ATB) as well as their use in the identification of potato varieties.

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The ATB investigations into colour identification are part of a Friweika e.V. Weidensdorf/Saxony project supported by the industrial research association working group Otto von Guericke e.V.

Keywords

Potatoes, quality assessment, colour identification

Literature

Literature details are available from the publishers under LT 02217 or via Internet at http://www.landwirtschaftsverlag.com/landtech/local/fliteratur.htm

The colour of fruit and vegetables often plays a decisive role in purchase decisions. In many cases the colour is a welcome sign of ripeness and, with that, taste as well as of desired or undesired components within the product. There are increasing reports regarding objective methods for colour identification in the fruit, vegetables and potato sectors [1 to 4].

In the context of this project, and as part of a exploitable-value analysis, different varieties of potatoes were compared for flesh and peel colours as well as for discolouration during cooking to help decision making in selecting varieties for cropping. To assist in this, suitable measurement methods had to be selected and, where necessary, adapted.

Basics of colour identification

Every colour comprises three characteristics: tone, brightness and depth. Together, these form the three-dimensional colour system *(fig. 1)*.

The tone forms the spectrum with red, yellow, green, blue, and the intermediate blends. Brightness is determined by proportion of white and black.

Depth characterises the intesnsity of the colour and applies independently of tone and brightness.

Various colour systems have developed on this basis [5]. Used in these investigations was the *L*a*b* system* with additional use of colour tables from the Natural Color System (NCS).

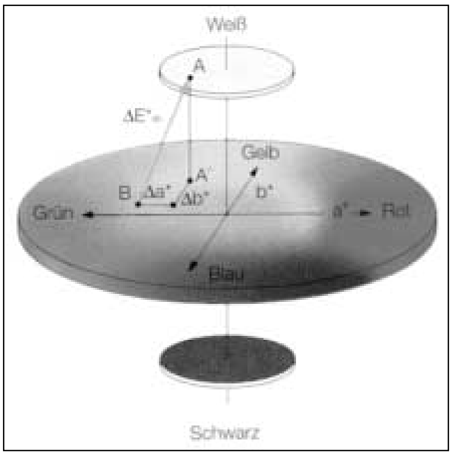


*Fig. 1: Three-dimensional representation of the L*a*b* colour system*

The *L *a *b * colour system* is already widely used for colour identification in nearly all application areas. It was defined in 1976 by the CIE [5]. The colour area is characterised by the brightness L* and the colour coordinates a* (red...green) and b* (yellow....blue). Thus +a* indicates a high proportion of red and -a* a high green one. In the same way +b* indicates high yellow proportion and -b* for more blue *(fig. 1)*.

The *Natural Color System (NCS)* comes from Scandinavia and is also oriented on the colour identification of the human eye.

Fig. 2: Determination of potato flesh colour via Minolta ChromaMeter 310

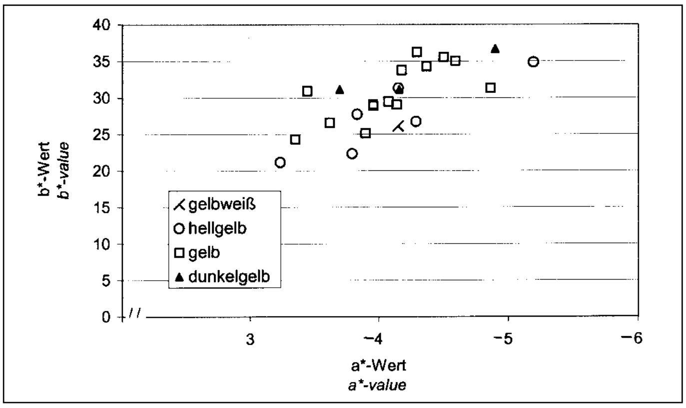


Fig. 3: Comparison of the a- and b*-values of the flesh colour of 23 varieties using the colour scale of the German FederalAgency for the Licensing of Varieties (BSA)*

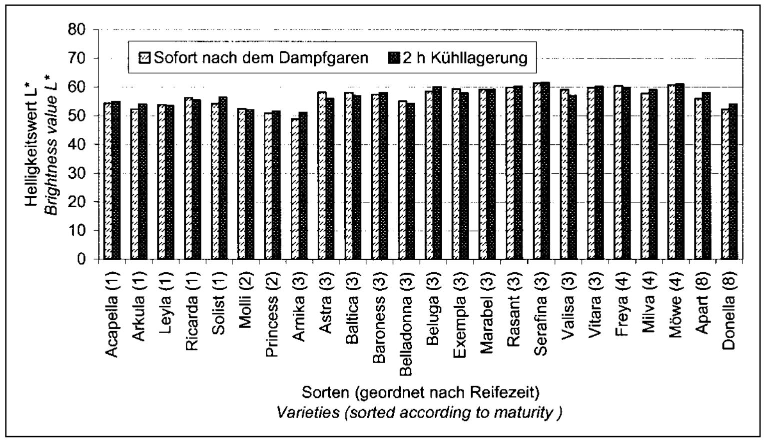
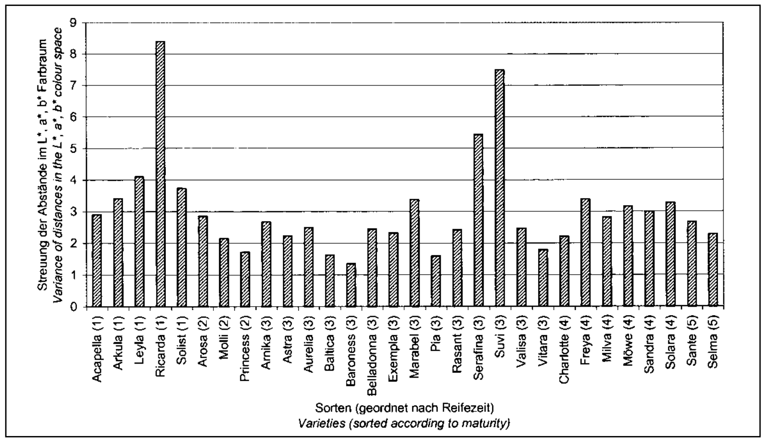


Fig. 4: Assessment of the discoloration after cooking following different periods before peeling

Fig. 5: Homogeniety of flesh colour with cooked potatoes



Basics in this case are the pure colours yellow, red, blue and green as well as black and white. From these, 1750 tone samples were created, available as colour cards and fans. The NCS advantages were used in investigations for the visualisation of the *L*a*b* colour system* measured values.

Material and methods

Over 30 varieities of potato were compared for suitablility in production of fresh potato products, being first cooked and then peeled (jacket potatoes). A three-year plot trial ensured the same growth and crop care conditions for all varieties.

A Minolta Chroma-Meter CR-310 was used for measuring the colours *(fig. 2)*.

Coloured tables from the Natural Color System (Scandinavian Colour Institute, Stockholm) were used for visualising colour values.

Results

Material from three different growth years was used for closer study of the method.

Evaluating flesh colour

To assess measured colour characteristics as quality criteria for the different varieities a colour pattern created from NCS samples was laid before an eight-member group of experts whereby in each case the yellow and green proportions were increased in five graduations.

The flesh colour of the cooked potatoes was able to be visually evaluated and classified „very good“ (1) through to „very bad“ (5). Dark yellow potato flesh was definitely favoured (marked 1.4) compared with light yellow (3.3). The evaluation was negatively affected as green proportion increased.

Tendencially coloured values of the raw potato flesh (a* and b*) and variety determinations of the Federal Variety Office [7] *(fig. 3)* were in agreement.

Assessing the cooking discoloration

The brightness (L*) was seen as suitable for the measurement of cooking discolouration [1]. The variatal differences were considerable when the brightness of the cooked potatoes immediately under the removed peel was measured *(fig. 4)*. Where the tubers remained unpeeled, a general increase in cooking discolouration through subsequent cool storage could not be proved. From the 23 potato varieties used in this trial only eight showed a lower L* value and thus an increase in cooking discolouration.

Assessing colour homogenity

The distribution of distances separating colours from a large number of individual measurements was accepted as an objective measurement for colour homogenity in carrot varieties by [2] With 20 measured objects there were already colour separations according to the following relationship

$$\Delta E^*_{ij} = [(a^*_i - a^*_j)^2 + (b^*_i - b^*_j)^2 + (L^*_i - L^*_j)^2)]^{1/2}; \quad \text{mit } i, j = 1,...., 20$$

A lesser variation in the distances between colours indicates increased variatal colour homogenity. This also completely applies for assessing colour development within a variety *(fig. 5)*. Clear correlations to L*-, a*- and b*- values as well as to starch content and to starch distribution in the individual tubers of a variety have not so far been able to be proved.

Conclusions

- Nowadays technical equipment is available for objective and therefore reproducable colour identification.
- Only through visual eassessment of colour value (in this case through the NCS colour sample) can the required key measurements for exploitation-value analyses be achieved.
- Through combining both colour systems it is largely possible to establish standardisation-level guidelines for agricultural products.