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The Quality Index: A holistic Approach to describe Quality of Food

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Introduction

Adequately assessing the quality of food grown with different cultivation methods is a constant problem. According to SCHUPHAN (1961), food quality consists of three main characteristics: grading, technological quality and nutritional quality. The latter involves the ratio between beneficial and harmful substances. Yet it is obvious that more than merely summing various substances is needed to assess the quality of food properly. This problem has been previously discussed by SCHORMÜLLER (1974) and KLETT (1968). A concept of quality that embraces the plant as a whole (and the internal equilibrium of the individual components) requires bringing together the results of multiple investigations in an integrated accounting that registers even slight differences. Examinations of food quality, moreover, have repeatedly tended to produce contradictory results. It may appear for example, that physiological imbalances within a plant create a low concentration of free amino acids - which is desirable since it theoretically implies a high concentration of essential amino acids (SCHUPHAN, 1976). However, the protein quality itself may remain low. Therefore, any statement concerning the quality of food which is based on a few parameters only proves to be insufficient. Isolated approaches might lead to wrong conclusions. Also differences in parameters must not be summarized hierarchically because relatively small differences would become overestimated. The Quality Index, condensing as many parameters as possible in an integrated calculation, might provide a way out of this predicament.

The Quality Index

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Early approaches to creating a Quality Index were made by BREDA (1973) and HUBER et al. (1988). The Quality Index presented in this paper continues this work but seeks to integrate several different parameters. This method was partly introduced by SCHULZ et al. (1992). The database for the calculation of this index was derived from carrots grown in a field experiment that has been carried out in 1988. Twelve ridge beds were established in an east-west direction to study the effect of light intensity (south sides with sun exposure and shady north sides), organic manuring (fresh horse manure and two-year old compost derived from horse manure), and biodynamic preparations (with and without). The three factors of irradiation (sun exposure or shade), manuring (fresh manure or compost), and biodynamic preparations (with or without) provided for eight different treatments:

1. SMB = South sides (S), fresh manure (M), biodynamic preparations (B).
2. NMB = North sides (N), fresh manure, biodynamic preparations.
3. SCB = South sides, compost (C), biodynamic preparations.
4. NCB = North sides, compost, biodynamic preparations.
5. SMU = South sides, fresh manure, untreated (U) (no biodynamic preparations).
6. NMU = North sides, fresh manure, untreated.
7. SCU = South sides, compost, untreated.
8. NCU = North sides (N), compost (C), untreated (U).

The index was calculated by using the following ten parameters: Dry matter, carbohydrates, nitrate, amino acids, protein quality, true protein ratio, storage loss, and, indicating maturity, the root/leaf-ratio, xylem/phloem-ratio, and the sucrose/sugar-ratio. Measured values were linearly transformed, with the lowest and highest values respectively assigned 0 and 100 points (For parameters where a higher value means lower quality, such as nitrate concentration, the endpoints were interchanged).

The results of such a calculation are illustrated in figure 1. The larger the difference between the values, the greater the gap between the different treatments on the x-axis.

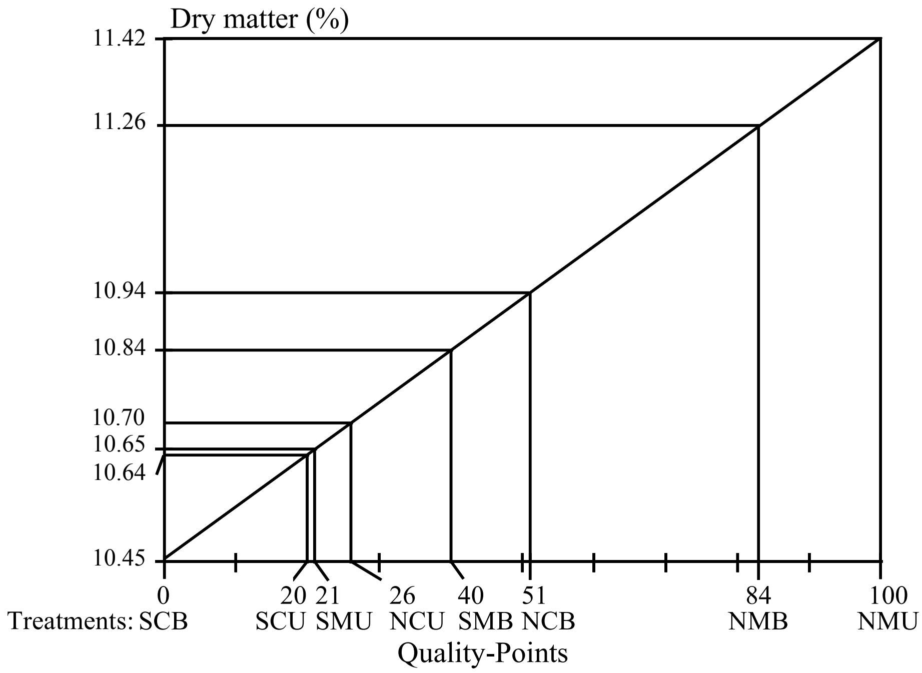

Figure 1: Quality points (parameter: dry matter).

In the same way, quality points were determined and summed up for every parameter, which resulted in the quality ranking shown in figure 2:

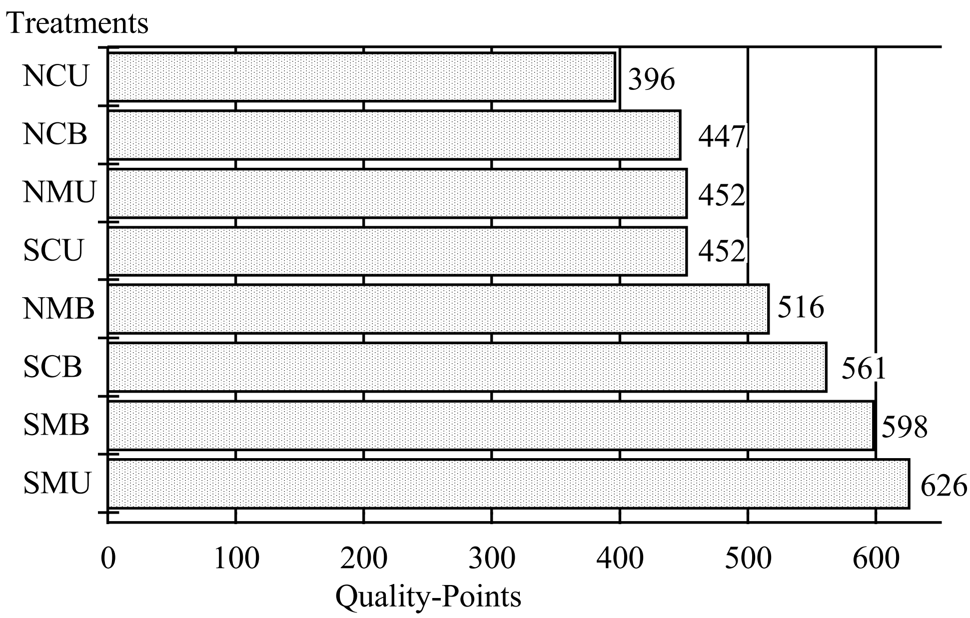

Figure 2: Quality ranking of the different treatments.

The following order (of decreasing quality) was established:

SMU > SMB > SCB > NMB > SCU = NMU > NCB > NCU

- Compared with their corresponding North side counterpart, each South side treatment obtained a higher score.
- Each fresh manure treatment scored better than the corresponding compost treatment.
- Except for treatments SMU and SMB (rankings 1 and 2, respectively), every treatment that was treated with the biodynamic preparations resulted in a higher quality than its untreated counterpart.

With this Quality Index it also seems possible to record visually the equilibrium of forces that exist within a plant (Figure 3).

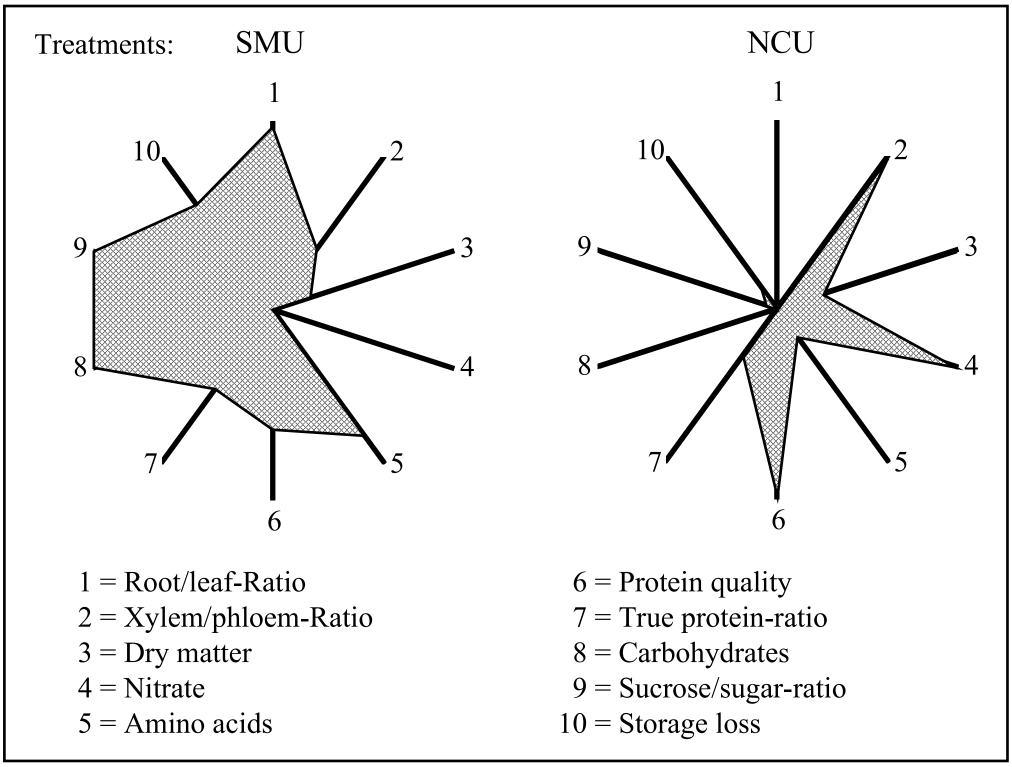

Figure 3: Equilibrium of forces within the NCU (right) and SMU (left) treatments according to the Quality Index.

The quality of treatment NCU (on the right) was classified lowest with the aid of the Quality Index, whereas treatment SMU (left) was assigned as highest quality within the samples. As can be easily gathered from this illustration, a nearly round shape is indicative of high quality. Quality increases as the shaded area in the graph becomes rounder and more filled in.

Enlarging the range and validity of the Quality Index

Unfortunately, the calculation of the Quality Index has so far been confined to the limits of a single experimental arrangement. It would be of great help to draw on the extreme values of comparative studies as well (e.g. SOUCI et al., 1994), which would allow for a wider empirical basis. This might, of course, involve the integration of extreme values that might cause scores of below 0 and above 100. But that must be considered positive, since the relative value of a parameter is better determined in relation to many experiments than among the different treatments of one set of experiments only. For example, an examination yields extremely low concentrations of nitrate (in comparison to the usual concentration), full appreciation of this fact would become possible only in contrast to comparative studies, whereas a single experiment could never warrant it. Nevertheless, the problem arises that previous and current examinations do not provide data for all the parameters employed in this survey. For this reason, the above-mentioned method has not been applied in the calculation of the Quality Index.

Prospects

The validity of the Quality Index will grow in proportion to the parameters it comprises. The DFG (Deutsche Forschungs-Gemeinschaft; German Research Society) sponsors a research group called "Optimizing Strategies in Organic Farming" which has been running extensive series of tests on how different fertilizing systems affect the quality of potatoes (HARTMANN and BÜNING-PFAUE, 1997; NEUHOFF ET AL., 1997; KOCH et al., 1997). These experiments include several characteristics relevant to the quality of food. This will make it possible for the first time to create a Quality Index with the following parameters of potatoes as integral parts:

1. content (dry matter, carbohydrates, starch, chloride, nitrate, phosphate, fluoride, selenium, ascorbic acid, potassium, magnesium, amino acids),
2. harvest parameters (e.g. grading),
3. changes during storage (contents, shelf life, germination),
4. strength criteria (skin strength, tissue strength),

5. sensory characteristics (taste, smell, color, consistency),
6. „vital quality“ (picture-creating methods)

With the aid of this new method we expect to distinguish even slight differences of produce quality.

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