# Impact of processing temperature on drying behavior and quality changes in organic beef

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## Background

The drying of meat has a long tradition as a preservation method and dried meat states a valuable protein source. However, processing needs to be adequate, since a high water and protein content makes meat very perishable.

As a snack food dried meat is well known as *jerky* (North America) or as ingredient for soups and meals as *charqui* (South America), and is usually cut into thin slices before drying.

In organic processing the use of food additives is highly restricted and the quality of the final product is significantly impacted by the drying process, which makes the definition of optimum process parameters indespensable. In this study, the influence of 50, 60 and 70 °C drying air temperature on drying behaviour and colour was investigated. Further, hyperspectral imaging (HSI) was used to investigate the relative reflectance of beef during drying and to build prediction models in terms of quality parameters of dried beef with regard to the development of non invasive control systems for drying devices.

## Materials & Methods

| | |
|---|---|
| **Muscle:** | *Longissimus dorsi* |
| **Size:** | 5 x5 x 0.5 $cm^3$ slices |
| **Drying:** | 50, 60, and 70 °C |
| **Measurements:** | weight, colour & HSI every 20 or 30 min the first 2 h, hourly until 15-20 % $MC_{wb}$) |
| **Repetitions:** | 4/temperature |

**Image Processing:**
Preprocessing, automatic detection and segmentation, calculation of relative reflectance spectrum by Matlab R2013a.

Development of PLSR model for prediction of quality parameters: RStudio, Data sets were split 70/30 for model building/model validation.

## Results & Discussion

**Drying behaviour and colour development (Figure 1):**
The drying curves for 50 and 60 °C show a similar development, the curve for 70 °C drying air temperature is significantly different, which can be explained by a higher heat and mass transfer [1], but also protein denaturation might be a reason [2].
The highest colour change (ΔE) was observed for the lowest temperatures, which might be due to a long drying time that further negatively influences the energy efficiency [3]. Drying at 60 °C showed the least ΔE while samples dried at 70 °C are inbetween, which might be caused by protein denaturation [4].

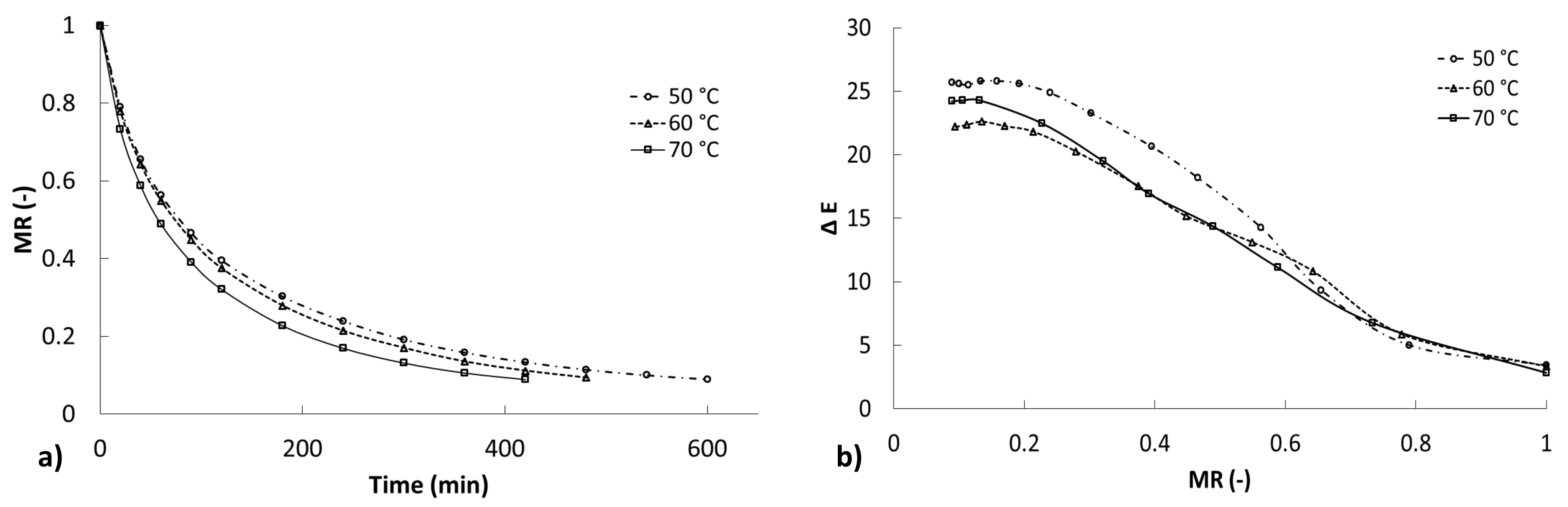


Figure 1:a) Drying curves of beef dried at 50, 60 and 70 °C, b) development of colour during drying.

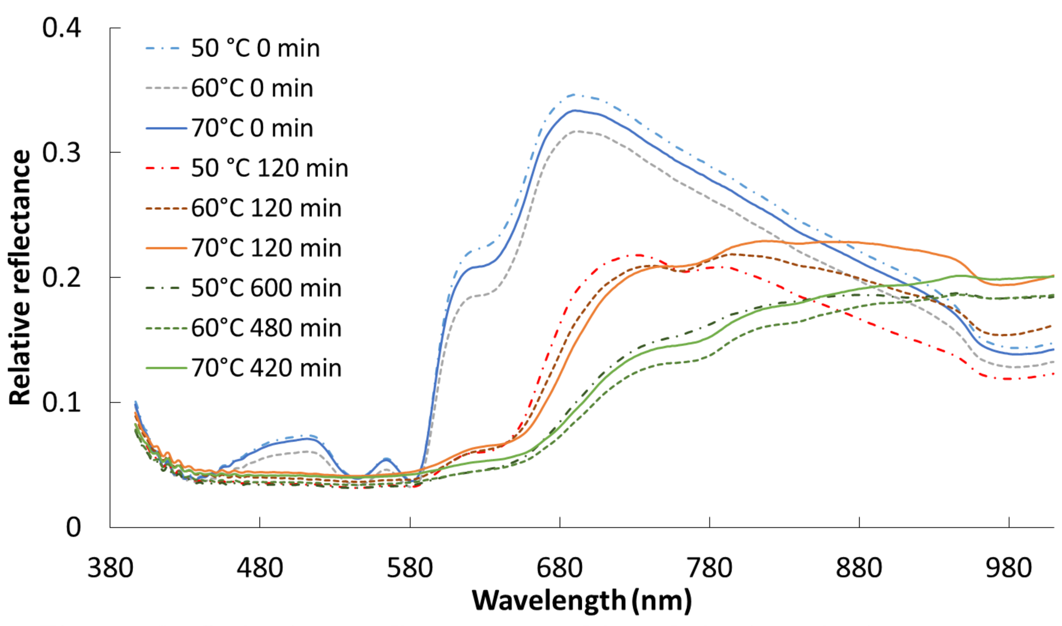


Figure 2: Relative reflectance of beef during drying after different drying times.

**Spectral data and prediction models:**
The relative reflectances are much higher at the beginning and decrease during the drying process, due to the moisture content and, therefore, decreasing lightness of the beef (Figure 2).

The building of PLSR models for MC resulted in very good results, which means small deviations between predicted and measured MCs at different drying times for 50, 60 and 70 °C (Figure 4 a)-c)), and, therefore, high regression coefficients (>0.97).
The inclusion of the whole data also results in a very well fitting PLSR model (Figure 4 d)). In a further step, the wavelengths, which mainly represent the model, need to be selected, which was already done for drying of beef of different qualities at 70 °C by Retz et al. (2017) [5].

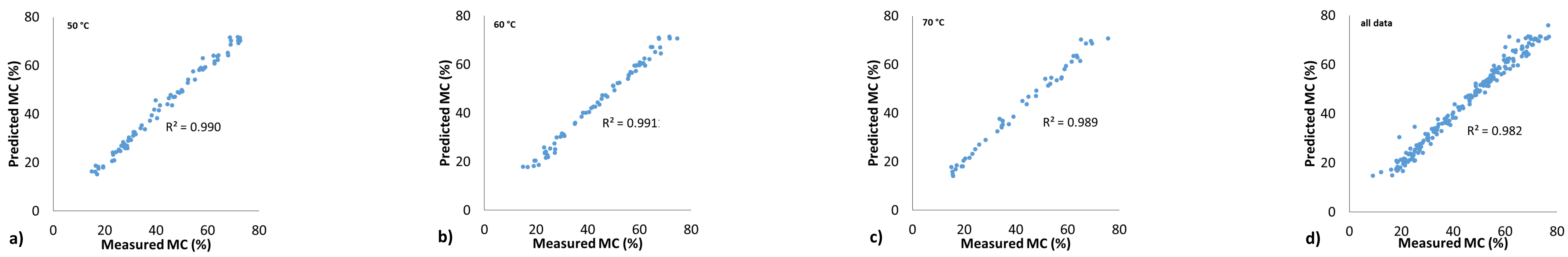


Figure 3: Measured vs. predicted moisture content (MC beef dried at a) 50 °C, b) 60 °C, c) 70 °C and d) all three temperatures ) related to developed PLSR models for based on the spectral data.

## Conclusions

The results obtained show that different drying temperatures affect the drying behaviour and colour change of beef and, therefore, are an important parameter in the processing of organic dried beef. The drying at 60°C seems to be the best setting as the colour change is the least compared to drying at 50 and 70 °C. The results from the HSI give promising results in terms of the development of non-invasive measurement systems for improved drying processes based on PLSR prediction models.

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