

# COMPARATIVE STUDIES OF PILOT PLANT AND INDUSTRIAL TRIALS ON THE ADDITION OF RE-FED MEAT ON QUALITY IN HAMBURGER

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## I. INTRODUCTION

In German food regulation the amount of non-intact cells (ANIC) in beef hamburgers, as well as in ground meat, is determined via histological analysis and limited to 20 Vol% to ensure consistent quality [1, 2]. Due to strong fluctuations within the histological method, up to 10 Vol% higher values are tolerated by the food monitoring authorities (FEI-PA meetings, personal communications, 2019 - 2022). During industrial production of hamburgers, it is unavoidable that a certain proportion of them is mechanically damaged and therefore re-fed to the process. In pilot plant trials it was found, that up to an addition of 20 % frozen, re-fed hamburgers, the limit values were not exceeded [3] and do not influence the structure and functionality of the hamburgers. The aim of this study was to check whether these results can also be transferred to an industrial production process.

## II. MATERIALS AND METHODS

Hamburgers from beef with a fat content of 18 % were produced in a pilot plant as well as in an industrial process, as illustrated in Figure 1. The experiments were repeated twice, with a batch size of 10 kg in the pilot plant, and 500 kg in the industrial process, and analysed subsequently. Frozen, deformed hamburgers were ground to a size of 16 mm and used as re-fed meat. Increasing amounts of re-fed meat, 0 %, 2.5 %, 5 %, 10 %, and 20 %, were added to the 13 mm pre-ground meat, replacing fresh meat in the mixer before final grinding. The subsequent forming of hamburgers was performed in the pilot plant with a modified patty-forming device (Type MH-100, Mainca, Spain) and in an industrial process with an industrial-forming device (Revo portioner, Marel, Iceland). The hamburgers ( $d = 100$  mm,  $h = 9$  mm,  $w = 90$  g) were frozen and packed in PE bags direct after forming. To ensure a uniform production process, the meat temperature was controlled at every processing step. To determine whether there were differences in the final product, between the pilot plant tests and the industrial production, the drip loss was determined and histological cross-sections according to the official German guidelines [4] were prepared. From the hamburgers of the pilot plant tests, additionally, a sensory analysis with 20 panellists was carried out. For this, the patties were grilled on a contact grill (Garland XPE 12, Canada), cooled, and reheated in a microwave oven at 800 W for 45 s prior to sensory analysis. An analysis of variance with the Tukey post hoc test was performed ( $p = 0.05$ ).

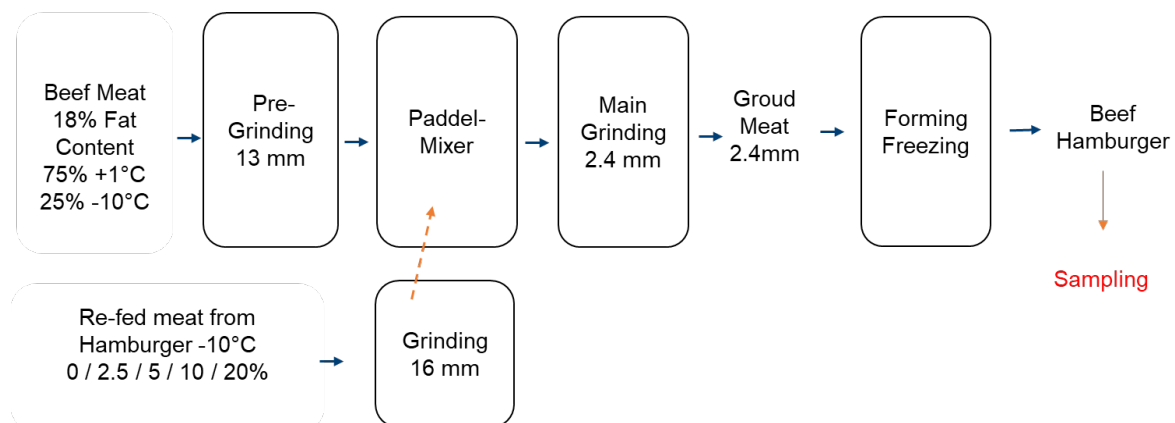


Figure 1: Flow chart of industrial hamburger processing.

### III. RESULTS AND DISCUSSION

As shown in Figure 2 (left), the amount of non-intact cells (ANIC) of hamburgers with 0 – 20 % re-fed meat ranged between 26.68 – 28.92 Vol% in the pilot plant trials, without having statistically significant differences between the samples. The industrially produced samples showed a slightly higher ANIC (27.24 – 29.61 Vol%). This difference between the trials can be explained by different raw materials and the different machine compositions. Also, no statistically significant differences occurred between the samples with increasing amounts of re-fed meat on the industrial scale. Only a slight trend towards higher ANIC at higher amounts of re-fed meat is visible. The same trend can be seen in the drip loss of the samples, which is approx. 2 % higher in the industrially produced samples than in the pilot plant ones. This can be explained by different raw materials. Figure 2 (middle) underlines, that there is no difference in drip loss of the samples if up to 20 % re-fed meat is added. The same applies to the sensory analyses (Figure 2, right), as all samples with different amounts of re-fed meat show a comparable overall acceptance very close to the standard (sensory score = 5) with no re-fed meat.

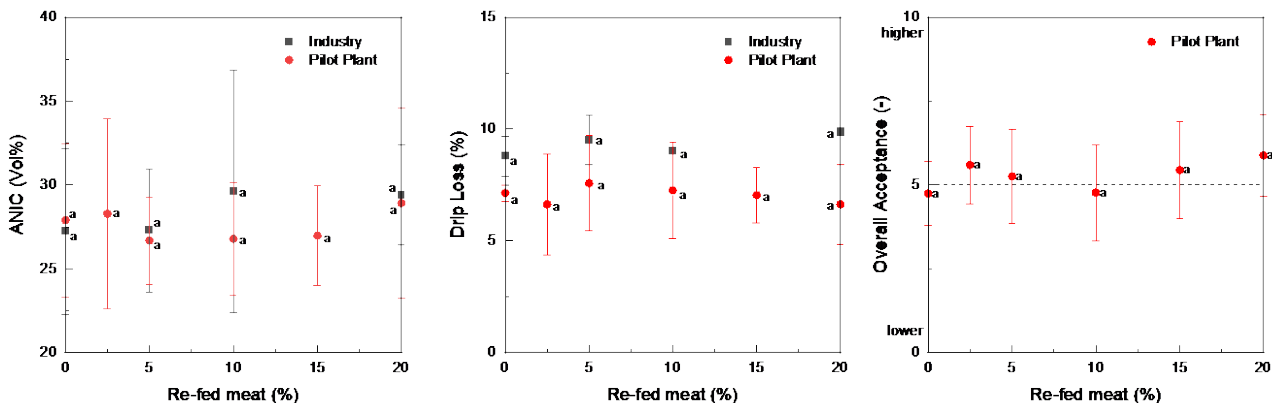


Figure 2. Amount of non-intact cells (ANIC) (left), drip loss (middle), and sensory analysis (right) of hamburgers produced in pilot plant and industrial trials. Data points with different letters are significantly different ( $p < 0.05$ )

### IV. CONCLUSION

The data indicate that the addition of re-fed beef to hamburgers obtained in the pilot plant trails can be transferred to the industrial process. Furthermore, it is evident that an addition of up to 20 % re-fed meat has only little influence on the ANIC, drip loss, and sensory properties of hamburgers. However, it should be kept in mind, that such high additions of re-fed meat are far from the usual practical additions of approx. 2 – 3 %. Re-feeding unimpaired, high-quality meat helps to meet ecological and economical requirements and contributes to more efficient and sustainable food production. But it is of the highest importance to take hygienic standards into account and ensure microbiological stability.

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### REFERENCES

1. Bundesanstalt für Landwirtschaft und Ernährung (2015). Leitsätze für Fleisch & Fleischerzeugnisse. Bonn.
2. Hildebrandt, G., Jöckel, J., (1980). Die Nachweismöglichkeit von wie Brühwurstbrät zerkleinertem Fleisch in Modellversuchen. Fleischwirtschaft 60: 392-403
3. Berger, L.M., Böckle, C., Gibis, M., Terjung, N., Weiss, J., (2023). Effect of re-fed meat in beef hamburger production. Journal of Food Engineering 353: 111526.
4. Bundesamt für Verbraucherschutz und Lebensmittelsicherheit (2006). Amtliche Sammlung von Untersuchungsverfahren nach § 64 LFGB, § 38 TabakerzG, § 28b GenTG: Verfahren zur Probenahme und Untersuchung von Lebensmitteln. Berlin: Beuth.