University of Kassel
Department of Organic Agricultural Sciences

Optimisation of herb dryers: Case study on the drying process for three hop farms in Strassbourg, France

Master Thesis
at the Section of Agricultural Engineering and Biosystems Engineering

1. examiner: Dr. Barbara Sturm
2. examiner: Prof. Dr. Oliver Hensel

Presented by: Jessica Lucinda Amprako

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Abstract

Abstract Hops (*Hurroulus kipulus L.*) are basically used in beer production to impart bitterness. aroma, flavour and for microbial stability. The substances in the hop that possess these characteristics are mainly alpha-acid and hop oils. Alpha-acid is an important quality index which most buyers and farmers in the hop industry concentrate on. Several studies in drying of hops have shown that the use of high drying air temperature and constant air speed offer opportunities to save energy and yield well-dried hop cones. However, several other factors also affect the drying and the quality of hop cones.

The methodology involved the drying of some varieties of hops in the three farms, Farm 1, 2 and 3, determining the relative humidity of the drying air, the drying time, the drying performance and alpha acid content.

Using three hop farms in Strasbourg, France as case studies, the hop variety, moisture, relative humidity of the drying air and different farm locations were reported to influence the level of alpha-acid in dried hop cones. Hop varieties which are noted for aroma reported low levels of alpha-acid from this study while high alpha-acid content was found to be the varieties known for less aroma compounds.

The drying methods adopted by the three farmers influenced quality of the dried hop cones. In that, the drying process that had fresh hop cones loaded to bulk depth higher than 25 cm and at high air velocity resulted in uneven drying. Other drying process

methods that reported longer drying time resulted in low moisture content of the final dried hop cones.

From this study, the energy efficiency and specific heat consumption were determined for the drying of Strisselspalt, Aramis and Triskel varieties on the three hop farms. The energy efficiency for Strisselspalt were found to be 4.7%, 6.5% and 7.6% and the specific heat consumption used was 5043.8 kWh, 3602.7 kWh and 3062.3 kWh for the three farms respectively. For Aramis, the energy efficiency was 4.2 /a, 4.7% and 6.5% and the specific heat consumption used was 5764.3 kWh, 5043.8 kWh and 3602.7 kWh for the three farms respectively. The energy efficiency for Triskel was 4.7%, 5.2% and 6.8% and the specific heat consumption used was 5043.8 kWh, 4593.5 kWh and 3602.7 kWh for the three farms respectively.

The energy analysis showed that Farm 3 had the highest efficiency and conserved more energy than the other farmers. The efficiency of drying Strisseispalt was high compared to Aramis and Triskel due to the nature of this variety. Low efficiency was attributed to poor air circulation, absence of heat exchangers and inability to re-use the energy trapped in the exhaust air.

To optimise the drying of hops on these farms, an alternative energy source such as solar energy is recommended as it provides a cleaner source of energy and helps in the conservation of energy. Regular servicing and maintenance of dryers and installation of a heat exchanger will improve the efficiency of the drying process.