Responsible, Low Cost, Disposal or Reuse of By-Products from Food Manufacture: Sustainable Uses of Spent Brewer's Yeast from Microbreweries

Sebastian Lunt ● sebastianlunt@gmail.com
Supervisors: Dr. Chris O'Malley and Sharon Joyce

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SUMMARY

The aim of the study was to highlight the benefits of sustainable practice for the micro-brewing industry, through the deduction of a sustainable, low cost re-use of spent brewer's yeast (SBY).

This is with the intention of nullifying the burden the disposal of surplus yeast has on the environment.

The feasibility of reusing spent yeast was investigated by completing a series of small pilot plant studies and the initiating of a network of breweries in the North East.

Figure 1 – Operation of rig

OBJECTIVES

- Optimise the drying of SBY on the prototype rig.
- Establish the suitability of surplus yeast as a by-product. This consists of moisture content, calorific value and cell inactivation analysis.
- Select a feasible area of by-product reuse whilst guaranteeing it's sustainable, low cost and has a long-term viability.
- Produce a survey in order to create a local network of microbreweries to share knowledge and best practice.

METHOD

A fractional factorial experimental design was made to optimize the prototype rig. After initial testing the factors of interest were temperature, drum speed and blade distance. The calorific value of a dried sample of SBY was found. Yeast was mixed with wort at 28°C to check for cell inactivation.

The moisture content (MC) was deduced for each experiment. This is achieved by weighing the SBY before and after placing it in an oven for 5 hours.

$$MC = \frac{Mass_{\ Initial} - Mass_{\ Dried}}{Mass_{\ Initial}} \times 100$$

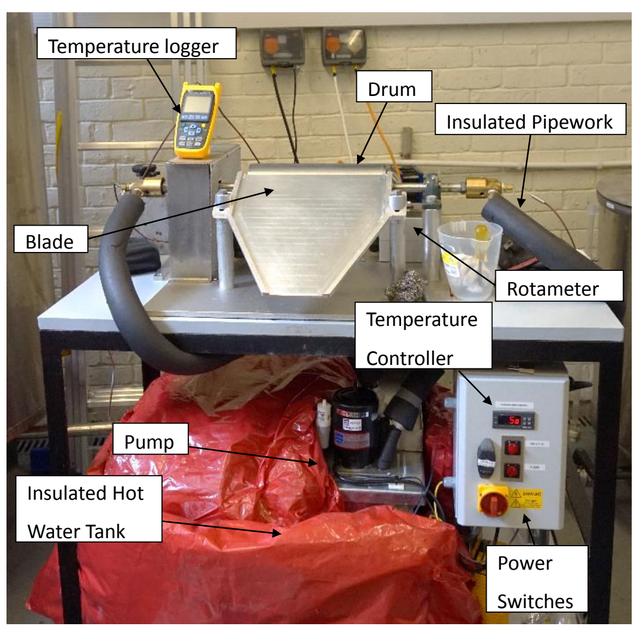

Figure 3 – Drying rig

SURVEY FINDINGS

- All the respondents disposed of their yeast waste down the drain.
- 50% of breweries are very concerned about the overall sustainability of their brewery.
- The main aim of improving the sustainability of their brewery would be to save costs.

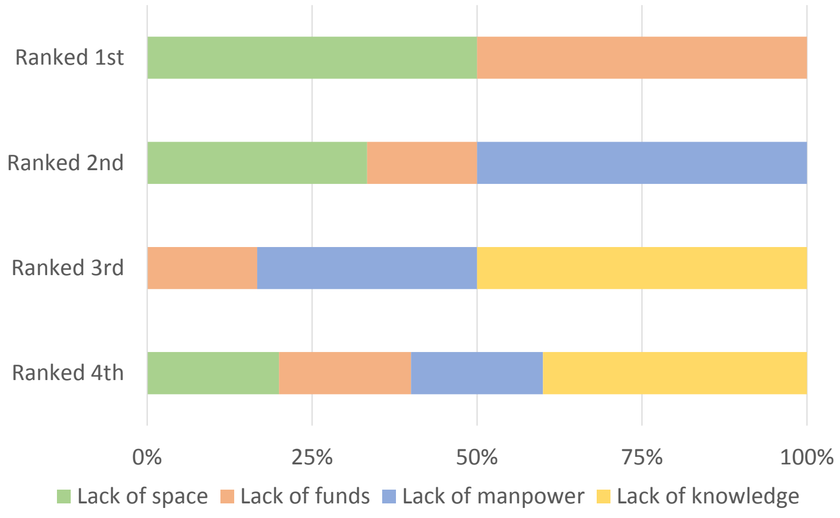

Figure 2 – Ranked obstacles breweries faced in becoming more sustainable

RESULTS

Table 1 – Average moisture content results

Temperature/ °C	Drum Speed/ rpm	Blade Distance/ mm	Average Moisture Content /%
75	0.4	2	56.1 ± 8.2
80	0.4	1	55.1 ± 6.0
77.5	0.6	1.5	62.0 ± 10.2
75	0.8	1	63.0 ± 7.7
80	0.8	2	60.7 ± 7.5

Figure 4 shows the temperature of the yeast on the drum surface. When yeast is heated to over 60°C, it inactivates the cells. The heating of the yeast allows it to be given to livestock (Huige 1994).

Statistical analysis showed that the best conditions were a temperature of 80°C, a drum speed of 0.4rpm and blade distance of 1mm.

The analysis also indicated that drum speed had the greatest influence on the moisture content. Figure 5 shows how the moisture content changes with varying temperature and drum speed. It indicates how the moisture content dictates the final moisture content.

The next step was to select the most feasible area of reuse. There is a range of options available (Ferreira et al. 2010). The following areas were deemed possible:

- Animal feed
- Biogas production
- Human consumption
- Composting

Animal feed was selected due to a larger potential market in the North East and minimal processing requirements. An interview with a Professor from the School of Agriculture and a farmer supported this proposal.

The moisture content of the yeast was reduced from 79% to 55% for the optimised conditions. Table 1 shows the average moisture content found for the operating conditions

The calorific value for the optimised conditions was 17.3MJ/kg, which is comparable to the soybean meal typically used for animal feed.

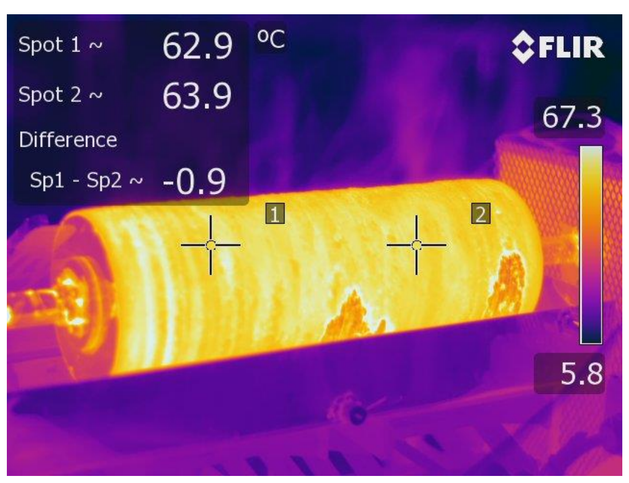

Figure 4 – Infrared Image (rear view)

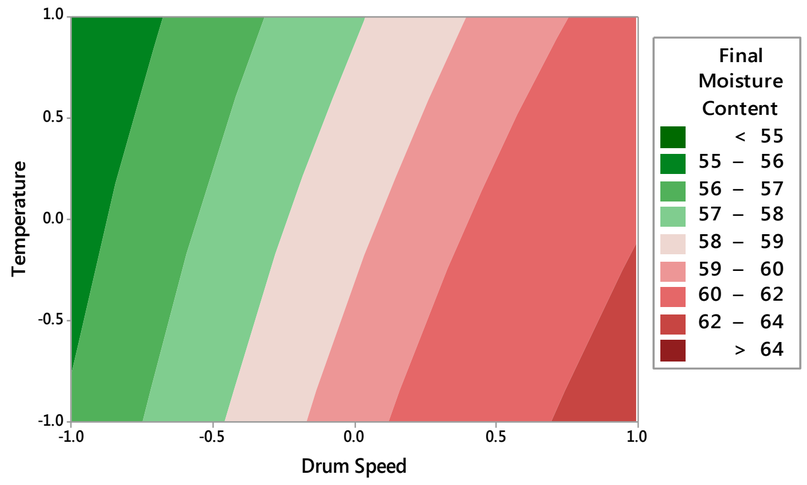

Figure 5 - Contour plot: moisture content vs. temperature & drum speed

CONCLUSIONS

The project highlights the benefits of sustainable practice for micro-breweries and that, instead of disposing of SBY, it should be harnessed to make a valuable by-product.

The sustainable reuse of spent brewer's yeast is important in reducing the detrimental impact of current disposal methods.

Optimisation of the prototype rig showed that the moisture content can be reduced by a substantial amount, which eases the transportation and storage issues.

The study suggests that the area of product reuse should be livestock feed. This is deemed feasible as the SBY is inactivated and it has a high calorific value.

REFERENCES

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Ferreira, I. M. P. L. V. O., et al. (2010). "Brewer's Saccharomyces yeast biomass: characteristics and potential applications." Trends in Food Science & Technology **21**(2): 77-84.