

1. What we know

Brewers' spent grain (BSG) composes the most significant portion of waste produced during beer brewing. It is usually discarded in landfills or used as livestock feed. However, emerging research suggests that due to its nutritional properties, it may be a viable, functional food ingredient for human foodstuffs [1,2].

Diminishing resources and climate change are putting pressure on agriculture to ensure food security. Thus, the food industry has an increasing interest in novel, low-cost sources of functional food ingredients [3,4]. This interest is further driven by consumers' demand for healthy food products and the growing "healthy snack" food category [5].



3. Methods

Muesli bar samples were produced with four different percentages of BSG to oats: 0% (control), 15%, 25%, and 50%. Colour and texture measurements were taken to assess the end-product quality of the muesli bars. Starch, total dietary fibre, protein, and ash were measured using enzymatic and gravimetric methods to determine the nutritional content of the muesli bars.

Prepared and ground muesli bar samples. From left to right, samples are ordered: 0%, 15%, 25%, and 50% BSG.



39 million tonnes of **brewers' spent grain** is produced globally each year.

Brewers' spent grain is shown to be high in **protein, dietary fibre, prebiotics, vitamins and minerals**

4. Findings: End-Product Quality

The addition of BSG in muesli bars had a significant effect on all colour parameters (Table 1). BSG caused the muesli bars to increase in darkness and redness but a decrease in yellowness. All samples with BSG were significantly different from the control ($p < 0.05$), except for the 15% BSG muesli bar, which did not significantly differ from the control in terms of redness.

No clear trend or significant difference was determined when comparing the hardness of the muesli bars. However, fracturability significantly ($p < 0.05$) decreased as the percentage of BSG increased (Figure 1).

Colour and texture are two key sensory parameters that affect the end-product quality and drive consumer acceptance [6]. The negative effects BSG has on the end-product quality of muesli bars will be a key challenge to overcome in the commercialisation of the product. Further research will be needed to determine how to overcome the negative sensory effects of BSG.

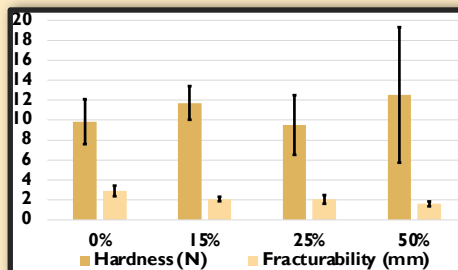


Figure 1: Texture results of the muesli bars, analysed in terms of hardness (N) and fracturability (mm). Results are the mean value of the duplicates \pm SD.

Table 1: Colour results of the muesli bars measured on a $L^*a^*b^*$ colour parameters. Results are the mean value of the duplicates \pm SD. Superscripts within columns denote significant differences between the samples ($p < 0.05$).

Sample	L^* (lightness)	a^* (redness)	b^* (yellowness)
0% BSG	68 ± 1.40^a	5.8 ± 0.34^b	26 ± 1.20^a
15% BSG	63 ± 0.93^b	6.0 ± 0.35^{bc}	23 ± 0.71^b
25% BSG	61 ± 0.43^c	6.4 ± 0.20^{ac}	22 ± 0.24^{bc}
50% BSG	57 ± 0.20^d	6.7 ± 0.11^a	21 ± 0.48^{bc}

2. What we wanted to find out

To determine whether BSG could be successfully upcycled into muesli bars as a functional food ingredient, and if so, its effect on:

1. The end-product quality of the muesli bars
2. The nutritional content of the muesli bars

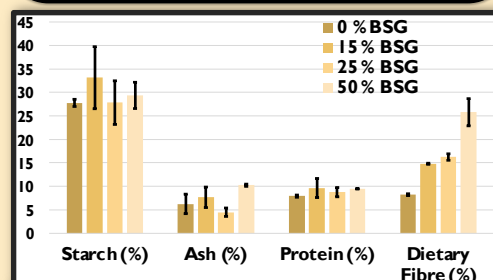


Figure 2: Nutritional composition results for muesli bar samples. Percentage composition was calculated on a wet weight basis. Results are the mean value of the duplicates \pm SD.

5. Findings: Nutritional Content

The addition of BSG in muesli bar has no significant effect ($p > 0.05$) on the level of starch or ash. There was also no significant difference in the level of protein, but all muesli bars with BSG did have a higher percentage of protein in comparison to the control (Figure 2).

Dietary fibre significantly increased in the muesli bars with the addition of BSG ($p < 0.05$). The addition of 15% BSG almost doubled the amount of dietary fibre in the control muesli bar, while the 50% BSG bar had more than three times the amount of dietary fibre in comparison to the control (Figure 2).

These results show that BSG does have a significant positive effect on muesli bar nutrition by providing higher levels of protein and a significantly greater amount of dietary fibre. This is of great interest to the food industry due to their interest in upcycled foods as a novel low-cost source of food ingredients [3, 4]. By upcycling BSG into muesli bars, the industry is able to develop high protein and high fibre muesli bars, thus meeting consumer demands for health food products. Future research on the prebiotic potential of BSG upcycled into muesli bars will be beneficial to understanding the health benefits of BSG inclusion in muesli bars.

Acknowledgements:

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References:

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