

Waste Minimisation in a Bakery Sector Food Business, South Wales, UK: A Case Study Analysis

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Introduction

Generation of food waste in the food industry includes unintentional loss and/or generation of food, water and packaging waste during all stages of the production process accounting for raw ingredients, part and completely processed products, through to final product assembly including plastic/cardboard packaging.

The Waste and Resources Action Programme (WRAP) estimate that food waste arising from the UK food and drink manufacturing sector is 1.7 megatonnes, with 51% of such waste (870,000 tonnes) reportedly 'avoidable'; 10% of this volume (90,000 tonnes) is reported to be attributable to the bakery, cake and cereals sector (WRAP, 2017). The reduction in the use of raw materials is considered to carry the greatest potential for financial savings (Henningsson *et al.* 2001). Minimisation of such losses may not only improve technological effectiveness but also be of substantial financial benefit for food sector businesses and increase potential sustainability.

Resource efficiency and waste reduction in the food sector is considered to be a priority for business optimisation. Data quantifying food waste during production is limited and assessment facilitates scope for improved efficiency and increased profitability.

Aim

The aim of this study was to determine waste production, processing efficiency and recommendations for waste minimisation and cost savings in a small and medium enterprise (SME) bakery.

Methods

Baseline product giveaway was quantified in a small established bakery consisting of 10 employees that produces up to 30 lines of baked/confectionery products for multiple customers, including local, national retailers and wholesale.

- Initial observations identified process flows and key stages of waste production for four product lines (including variations of slab fruitcakes).
- Prior to undertaking observational audits, SME specific audit checklists to record quantitative measured product volumes and weighed ingredients during mixing, depositing, baking and packing were designed, developed and piloted.
- An in-depth observational assessment during production and packing was undertaken for four product lines to capture data indicating measured processing waste volumes during weighing, baking, final assembly and packing (Figure 1).
- Data collected was compared with company product specifications; recommendations and costs savings were calculated.

References

- WRAP (2017) Estimates of Food Surplus and Waste Arising in the UK. Available from: http://www.wrap.org.uk/sites/files/wrap/Estimates_20in_the_UK_Jan17.pdf (Accessed 11/08/17)
- Henningsson, S., Smith, A. and Hyde, K. (2001) Minimizing material flows and utility use to increase profitability in the food and drink industry. *Trends in Food Science and Technology*. 12(2), p75-82.

Results and Discussion

Production process flow

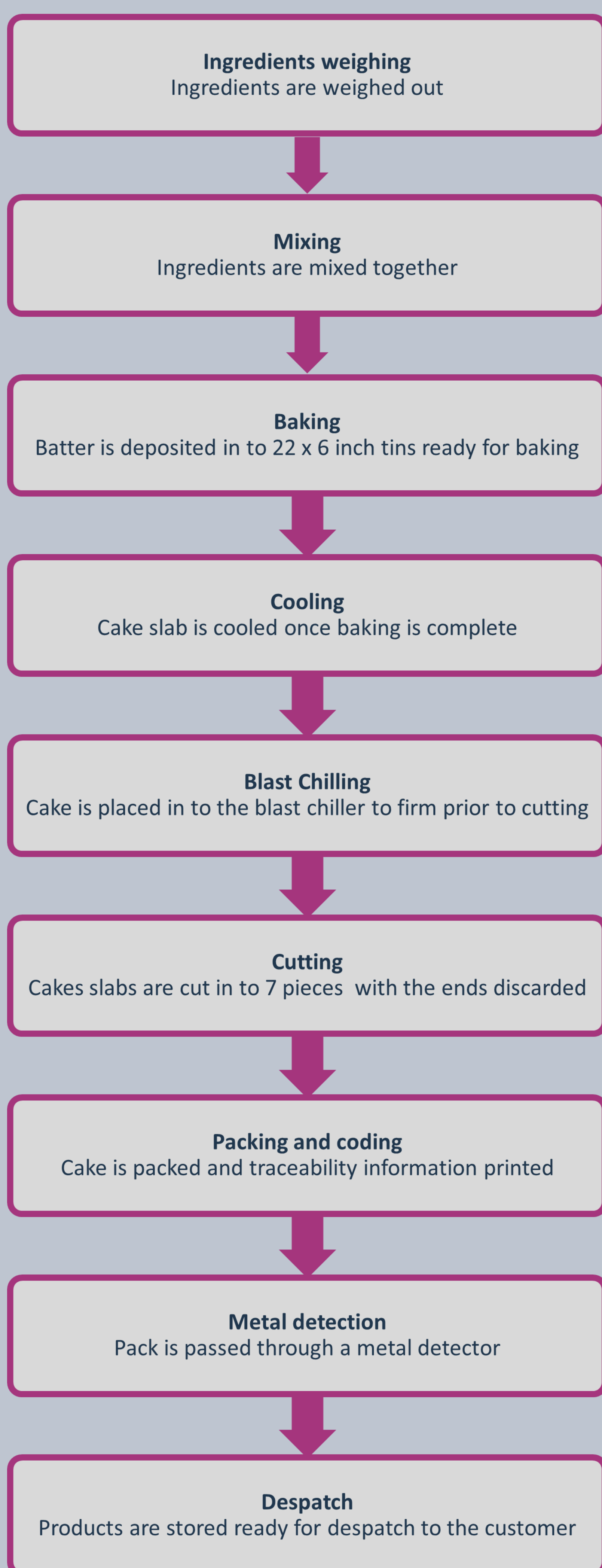


Figure 1. Bakery SME production process flow

Table 1. End product specification and target weight adherence

Batch details	Product 1	Product 2	Product 3	Product 4
Specification target weight	310g (±10g)	310g (±10g)	350g (±10g)	350g (±10g)
Above upper target weight	83.6%	82.1%	85.7%	85.3%
Upper weight tolerance	12.2%	7.1%	3.6%	2.9%
Target weight	0.0%	1.9%	0%	0.0%
Lower weight tolerance	2.1%	8.9%	10.7%	2.9%
Below lower target weight	2.1%	0.0%	0%	8.9%

Waste analysis audit

Weighing: All ingredients were weighed correctly according to the target weight.

Mixing: Post-mixing, the batter was deposited into cake tins measuring 22 x 6 inches to produce a large slab of cake.

Baking/Cooling: Post-bake analysis found that all products were within the correct specification for bake loss and yield post baking and cooling.

Cutting: During the cutting process each cake slab was cut into 7 pieces with the ends discarded as 'waste' straight into a bin. During this process it was noted that up to 10Kg of waste offcuts were directly discarded during a production run (Table 2).

Packing: Data presented in Table 1 illustrates the packed end product specification and target weight variation. Overall, 88.2-96.0% of baked products were within the maximum weight specification range or higher (Table 1). One sample weight was found to be 34% heavier than the target weight.

Potential savings post-adoption of recommendations

Process Control: Use of specific gravity to measure mixed batter enabled a possible reduction of the mixing time by 5 minutes for each product, with no effect on product quality.

Reduction in the waste offcuts: Reducing the mixed batter drop weights by up to 10% into the cake tins and increasing the finished cake cut size from 56-58mm to 63-65mm per cake, would produce a product closer to the target weight and would reduce the remaining waste off cuts by 42% -50% (Table 2).

Savings: Savings identified during the process equate to £0.03 per cake, per batch. Reduction of batter weight and increase of cake cut size, resulted in an annual saving of up to £1965 per year for a single product (Table 2).

Processing time: The reduction in batter mixing time of 5 minutes per product equated to a reduction in processing time by up to 52 hours a year based on an average of 3 batches of cake being produced a week for the 4 products audited. A reduction of 52 hours processing time over a year could achieve further savings for the company relating to labour and energy efficiency through electric, heating and water (Table 2).

Table 2. Baseline waste assessment, increase in yield and potential savings per batch

Baseline waste assessment	Product 1	Product 2	Product 3	Product 4
Cakes per batch (Qty)	389	389	350	339
Direct waste per batch processed (Kg)	10.0 Kg	9.8 Kg	9.9 Kg	9.8 Kg
Potential Savings				
Reduction in batter drop weight (%)	7.4%	3.7%	10.0%	9.7%
Increase in cake tins produced per batch (Qty)	4.4	2.14	5.5	5.2
Increase in cakes per batch (Qty)	420	404	389	375
Reduction in waste off cuts per batch (g)	90g	78g	90g	84g
Reduction in waste off-cuts (%)	50%	44%	45%	42%
Saving per cake per batch (£)	£0.03	£0.03	£0.03	£0.03
Annual savings based on producing an average of 3 batches per week (£)	£1,965	£1,890	£1,820	£1,755
Total time saved with reduction in mixing time per batch (mins)	5 min	5 min	5 min	5 min
Total time saved annually per batch in hours, producing an average of 3 batches per week (hrs)	13 hr	13 hr	13 hr	13 hr

Conclusions

- Observational audits of waste production indicated substantial baseline wastage, variable giveaway and inconsistent end weights; up to 96% of end product weights were within or above the higher target specification weight range.
- Recommended minor amendments to mixture weights and processes resulted in potentially significant SME cost and time savings.
- Implementation of recommended processing techniques may improve production efficiency, reduce direct waste and potentially increase SME profitability and business sustainability.