Strategies to replace flour chlorination as a treatment for cake flours

Summary
Chlorine gas is used for the treatment of flour for cake production. However, it is a dangerous chemical and there are health and safety concerns associated with its use. Chlorine has been banned as a flour treatment agent in a number of countries and it is anticipated that this will also happen in Australia. This project undertook the development of cost effective commercial technology for producing chlorine free cake flours for the domestic industry. An effective strategy to replace chlorine gas treatment has been demonstrated. The solution includes wheat selection, milling recommendations and an improved heat treatment technique.

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Conclusions

It was not possible to completely replace the effect of chlorine gas for the production of high ratio cake flour. However, the system developed in this project appears to provide a better solution for the production of non-chlorinated cake flours than those commercially available.

The developed system produced cakes of a higher standard than commercially available flours from the United Kingdom (UK) and Japan. This result was achieved using the BRI test baking method and an independent bake test in the UK will provide a comparison between the Australian and UK flour treatments in a UK based cake system.

The system developed by this project requires less processing stages than the currently available commercial systems. This is expected to reduce the cost of processing.

The treatment system developed by this project is approximately 10 times faster than the currently available commercial systems. This is also expected to reduce the cost of processing.

A cost comparison is not available on the newly developed process at this stage. This would be developed if the project progresses to a business plan. If the final treatment conditions allow in-line treatment, this system will become highly competitive and could be expected to replace the existing technology.

Recommendations

It is recommended that a business plan to commercialise this technology is completed. It is possible that the system could substantially reduce the cost of flour treatment. The plan could be used to seek investment from parties such as mill equipment manufacturers.

Outcomes

The project has demonstrated a strategy to replace the use of chlorine gas for the treatment of cake flours. There are three scenarios under which this strategy may deliver economic benefits to Australia.

Scenario 1

Chlorination treatment is not banned in Australia.

An evaluation is in progress to compare the flour produced using the new strategy with commercial flour in the UK. If the Australian flour is shown to be of superior quality, then a commercial evaluation will be completed to determine if this product can compete in overseas markets. If the economics are favourable, there is an opportunity for exports of treated cake flour. This would create a value added flour market. Part of the solution does require specific wheat types and it is anticipated that soft wheat grown under contract which meets the required specifications would attract a premium. The UK market represents approximately a 300,000 tonne opportunity for cake flour. Other countries such as Japan may also represent...
opportunities for treated cake flour.

**Scenario 2**
Chlorination treatment is banned in Australia.
The strategy for the production of cake flour developed in this project has the potential to reduce the cost of non-chlorinated cake flour and to maintain a higher standard of cake quality. The result of this would be the maintenance of domestic markets for cake flour. The alternative is the heat treatment systems applied in countries such as the UK which have a high capital cost and have resulted in significant price increases for treated flour. Under this scenario, the potential to supply overseas markets would also apply (see Scenario 1).

**Scenario 3**
The heat treatment technology may have commercial value in its own right independent of what happens in Australia with regards to chlorination. This technology could be licensed to equipment manufacturers for application in other markets.

**Environmental**
Under Scenario 2, the use of chlorine treatment would be stopped with a viable alternative. This would result in some environmental benefits and would certainly be good for the image of the cereals industry. Not only would the product appear to be more healthy, but the production system is safer.

**Achievements/Benefits**
The project investigated a wide range of options for the replacement of chlorination.
These included the following:
Wheat selection
Flour milling variables
Added starch
Starch treatment
Ozone treatment
Oxygen treatment
Starch annealing
Use of cake formulation and ingredients to modify flour properties
Heat treatment

From these options, the most promising were selected for optimisation. This included wheat type and for the optimisation work, the variety Rosella was specifically selected. Milling conditions were required to produce flour with the following properties; very low particle size (extra pin milling was applied to commercially produced flours), low starch damage, low protein content and low ash level.

The flours were then heat treated using a newly developed system. The new system has eliminated the need for a pre-drying step which is used in commercially available heat treatment systems and has reduced the treatment time from 20 minutes to less than two minutes. It is expected the reduction in steps and the increased speed of the treatment will reduce the cost, however the economics of this will be dependent on the final system.

The optimised system produced cakes that were up to 95% of the score achieved for chlorinated cakes and this was an improvement on commercially available heat treated flours from the UK and Japan. The optimised flour was also evaluated in a range of cakes other than sponges and was found to achieve good outcomes.

A request has been made by Allied Milling to send flour samples to the UK for evaluation. The flour will be compared to commercial UK flours in a UK cake system. Flour samples will also be provided in adequate quantity for Allied Milling to evaluate. This work is still in progress and is expected to be completed by the end of the current year.

Further development of this system and commercialisation options will be considered once the results of the UK testing have been obtained.

The developed system has some potential to be added as an in-line treatment rather than the current batch treatment. In this case, the system would be expected to provide significant cost reductions.

**Other research**

If the comparison of Australian flour with the commercial UK flour to be completed by Camden and Chorleywood is favourable, then further development of this technology is recommended. This would require further optimisation of the processing conditions and the development of a pilot scale plant. This would enable full evaluation of the processing cost using this system and its viability at a commercial scale. It is recommended that this stage is either undertaken with a flour milling partner or an equipment manufacturer.

A further opportunity has been identified for the online measurement of flour heat treatment. During the course of the project, a rapid visco analyser (RVA) method was developed to monitor the heat treatment of flour. While this system allows checking of the flour without requiring cake production, it is still a post treatment system providing quality control (QC) but not quality assurance (QA). It is considered that on-line near infra-red (NIR) may have the potential to measure the same changes identified by the RVA. This would provide a QA monitoring system. This proposal could apply to both the existing commercial heat treatment systems or the newly developed system developed in the context of this project.

**Intellectual property summary**

If the project is to be taken to commercialisation, a patent for the specific treatment developed by this project is proposed.

**Additional information**

K Germaine, K Quail, C Walker and D Miskelly, 2004. Comparison of the changes to starch properties with flour heat