on the diagram. As a cake bakes, this zone moves progressively down from the surface towards the core. This zone is important because its high water vapour partial pressure means that water vapour diffuses from it in both directions: in to the core of the cake and out to the surface. Water vapour therefore no longer transfers heat from the surface. Heat transfer also becomes limited by the poor conduction of heat through the dry cake surface.

The results are interesting, although the baking conditions used by the French researchers were quite different from normal. The cakes contained no baking powder so expansion was only due to expanding gases. Cakes were baked in an insulated mould so that all heating was from the top. Also, the cake surface was covered with carbon powder so that its temperature could be measured. Temperatures were measured at the surface and at various depths. The cake pan was suspended from a balance while baking to measure its weight. Height was monitored continuously with a video camera. Some cakes were sampled at different times to measure changes in water activity, moisture content and texture. Similar results ocurred for oven temperatures between 200-240°C and batter depths of 2.5 - 4.1 cm. The difference from normal baking conditions can be judged from the baking times of up to 2.75 hours.

The paper was written by M Lostie, R Peczalski, J Andrieu and M Laurent. Study of sponge cake batter baking process. Part I: experimental data. Journal of Food Engineering 51 (2002) 131-137.

New waxy durum wheat flour is claimed to replace fat in bread

A new kind of waxy durum wheat flour is claimed to replace fat in bread without reducing bread quality. The new wheat has been developed by scientists of the USDA Agricultural Research Service. If the claim is true, the bread should be popular with calorie-conscious consumers, while bakers could save on the cost of fat.

Use of 20% of the new flour (of dough weight) worked best as a fat replacer. The volume, texture and softness of quarter pound (113 g) experimental loaves containing this amount, but without fat, were equal to those of bread made with normal wheat flour and fat. The cereal chemist for the project suggested that the key was in the unusual starch in the waxy durum.

Starch in the waxy durum wheat flour is nearly 100% amylopectin, while that in ordinary bread flour contains about 24% amylose. The high amylopectin starch is waxy, absorbs much more water and remains gooey after heating and cooling. The ARS finding that their experimental bread remained much softer than the control after five days seems consistent with C&FR researcher Dale Every's results on the role of amylose in staling.

Obituary - Alan Carpenter

Crop and Food Research entomologist, Alan Carpenter, MSc (Hons), PhD, died unexpectedly on February 7 after a serious illness. Alan was involved with the flourmilling and baking industry through his research on controlling insects in food premises.

A highlight of Alan's research career was BOC gases' adoption of technology he developed to fumigate food and ornamental products in an environmentally-friendly way.

Alan also developed a heat treatment for killing thrips in asparagus for export that removed the need for fumigation. Both of these technologies have already provided significant benefit to the horticulture industry.

Alan was passionate about life and science and had a phenomenal memory. His innovative approach to solving practical problems was suggested by the title for his presentation to the 1998 New Zealand Flourmillers Association Technical Conference, "How to ensure that your mill HAS insect problems." Alan is survived by his wife and three children.

The Flour Milling and Baking Industry Research Trusts publish this newsletter with Crop & Food Research to present the results of levy-funded research and other information relevant to New Zealand industry.

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New Zealand Flour Millers Association Inc.

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Ideas and information from milling and baking research

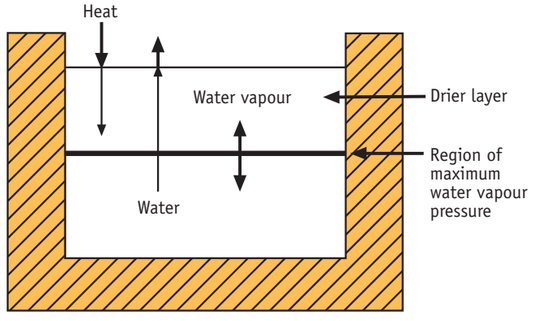
Milling & Baking News
NEW ZEALAND

PLEASE CIRCULATE TO: ☐ *General Manager* ☐ *Bakery Manager* ☐ *Sales* ☐ *Staffroom*

THE BAKING OF SPONGE CAKE BATTERS

Baking products are difficult to study because several different processes are occurring at once. Previous research on bread found that in the second stage of the baking process, the core tends to plateau at an almost constant temperature as the damp dough in the centre is surrounded by a layer of dry crust. This article summarizes the findings of French researchers who set up a 'model' system to bake sponge batters so that they could control or measure many of the variables.

As the cake batter starts to heat, regions of the cake batter begin to differ in temperature, moisture content and water vapour pressure. These regional differences, or gradients, cause several changes. Heat convects from hotter to cooler areas, moisture diffuses from areas of higher to lower concentration and water vapour diffuses from areas of higher to lower vapour pressure. The water vapour pressure is greater beneath the cake surface so vapour diffuses from the top surface towards the cold core of the cake. This increases its moisture content. The diffusing water vapour also transfers heat from the surface to the uncooked batter because it releases heat as it condenses.



Previous work found that biscuit doughs released large amounts of gas as soon as the dough proteins coagulated, at 70-90°C, depending on sugar content. Cake samples taken at the first and second baking stages showed that pore size, porosity and permeability all increased greatly. During the second baking stage cakes reached 90°C and their structure stiffened. The opening of the cake structure favoured the rapid transfer of heat by the convection and diffusion of gases. The dry area of crust behaved like a porous barrier for heat and water transfer and was more uniform in temperature, water content and gas vapour pressure. The drying and baking rates of cakes were limited by the rate of heat conduction through the dry crust, (**see diagram**).

The diagram represents a cake at the later baking stages, when the large differences in temperature and moisture content decrease. As the cake structure opens up, heat transfer by the diffusing water vapour accelerates, so the differences between the crust and the unbaked batter become smaller (gradients decrease). The surface layer dries and its water activity decreases as liquid evaporates faster from the surface than it diffuses from the cake core. An area of maximum water vapour partial pressure forms, which is represented by a line

continued on the back...

Top breadmaking apprentice

The New Zealand Association of Bakers awarded the 2002 Hawker Award for the top bread baking apprentice in New Zealand to Kristopher Burn of Quality Bakers, Hawkes Bay.

New measure accurately predicts the effect of foods on blood sugar levels

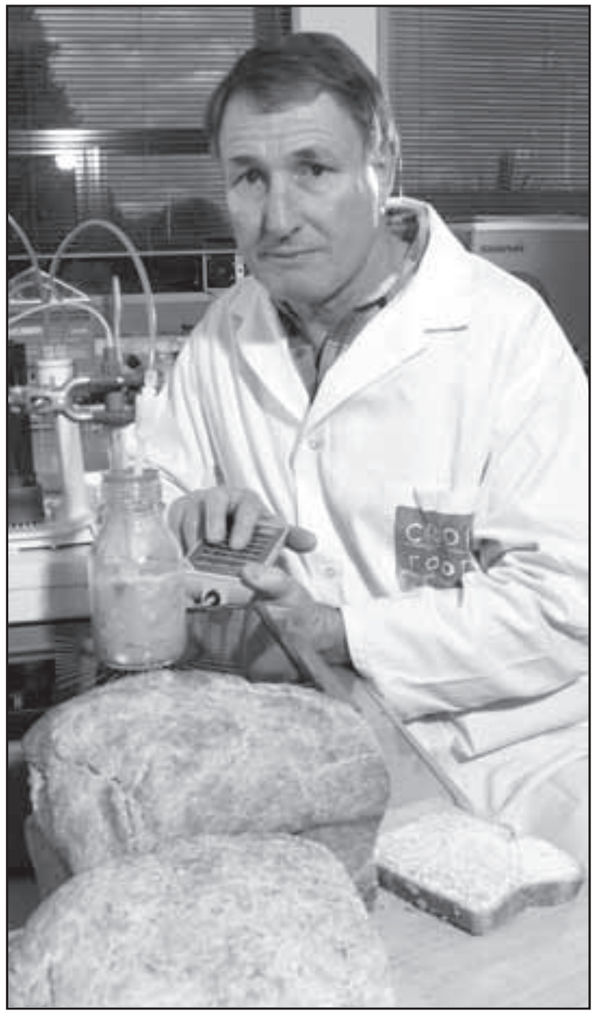
A new measure developed to predict the effect foods have on blood glucose levels has been successfully validated in recent clinical trials at the Otago Medical School. Crop & Food Research nutrition scientist, John Monro found that the glycaemic index does not give an accurate measure of the effects that foods have on our blood glucose levels. John explained his GGE concept in his report to BIRT, Beyond the GI factor - bread is still the staff of life.

In associated work funded by FRST John developed the new concept of Glycaemic Glucose Equivalents or GGE. John says, "To accurately estimate the blood glucose impact of particular foods, we need a calculation that takes into account glycaemic index, food carbohydrate content and serving size". GGE combines this data to provide a useful tool to manage blood sugar levels (glycaemia) for diabetics and others. GGE is defined as the weight of glucose (g) that would cause the same increase in blood glucose as an amount of food (either per serving or per 100 g).

The GGE measure performed well in a clinical trial of 12 diabetic and 12 non-diabetic volunteers. GGE successfully predicted patients' relative blood glucose responses following consumption of foods varying in size, glycaemic index and carbohydrate composition. Results predicted from GI values were inaccurate.

Volunteers consumed two serving sizes of foods chosen to provide a range of carbohydrate content: yams, biscuits, white rice and porridge. Blood glucose results, monitored for three hours, showed large individual differences in responses to dietary carbohydrates but each individual's responses were consistent. Each volunteer's blood sugar levels were generally proportional to the calculated GGEs, a relationship that was consistent for different foods, carbohydrate intake and food intake. However, for technical reasons the results for rice did not agree with the other foods.

This limited trial provides good evidence that GGE intake accurately predicts glycaemic response to foods containing a range of carbohydrate levels, after adjusting for individual carbohydrate responses. If so, GGE could be used to control dietary carbohydrate intake and thus blood sugar levels for diabetic patients. If sufficiently accurate, GGE could improve adjustment of insulin or other medication to GGE intake.



John Monro, Crop & Food Research nutrition scientist.

The GGE concept also has the great advantage that grams of glucose would be understandable to most consumers. Because GGE takes actual food intake and serving size into account, it can be treated as a food constituent. This is not true for GI. As GGE measures the glucose effect of a whole food, not just the carbohydrates, it should apply to a wider range of foods and mixed meals. This will be tested in further clinical trials.

BIRT and the baking industry should be congratulated for supporting the work that developed the GGE concept because it appears to have great potential as a useful tool to manage blood sugar levels for diabetics and others. John explained his GGE concept in his report to BIRT, Beyond the GI factor - bread is still the staff of life, Crop and Food Research Confidential Report No. 383, January 2000.

John Monro is concerned that the glycaemic index (GI) is being incorrectly used to promote food products. "It is of concern that GI is being promoted to the public and to the food industry without clearly communicating its limitations", he says. "By itself, it cannot indicate how strongly a food will affect blood glucose levels."

The glycaemic index is sometimes assumed to rank foods according to their impact on blood glucose and has been used for predicting glycaemic response. However, GI does not give accurate information on the relative glycaemic effect of different foods, unless they are of the same serving size and carbohydrate content. This is because GIs do not take into account differences in food composition or food intake that are part of normal eating patterns.

The glycaemic index is a clinical measurement of the effect of consuming 50 g of carbohydrate on blood glucose levels compared to the effect of 50 g of glucose.

Furthermore, the figures cannot be converted in a common-sense way to allow for the amount you eat. John says it is misleading to suggest that GIs may be used directly to predict relative blood glucose responses across a spectrum of carbohydrate foods. Take three examples of foods with similar GIs: glucose, rice bubbles and parsnip. If GI indicated glycaemic impact, you would expect the same weight of each to cause the same blood glucose response. This is not true because parsnip contains much less carbohydrate than glucose (83% of it is water). In fact, their relative glycaemic effects are very different. (See **Table 1** below).

Table 1: Glycaemic index example data using glucose, rice bubbles and parsnip.

	GI	GGE
Glucose	100	100
Rice Bubbles	95	74
Parsnip	97	12

John calculated GGEs for 133 common foods from food composition data, GIs and serving sizes. Foods were divided into low, medium and high GI groups. The graph shows that there is little relationship between GI and GGE, although they are related for breads and breakfast cereals, which are more similar in composition and serving size, (see **Figures 1-2**).

"It is of concern that GI is being promoted to the public and to the food industry without clearly communicating its limitations."

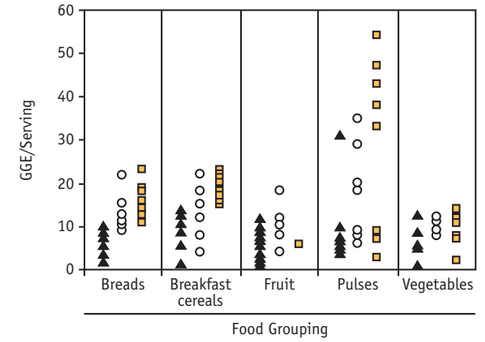


Figure 1: Relative glycaemic impact (GGE per serving) for foods classified into GI categories: low (<55, ▲), medium (55-70, ○) and high (>70, □).
GGE data is per serving; slice of bread, item of fruit or cup for foods in the form normally consumed; most fruit raw but vegetables cooked.

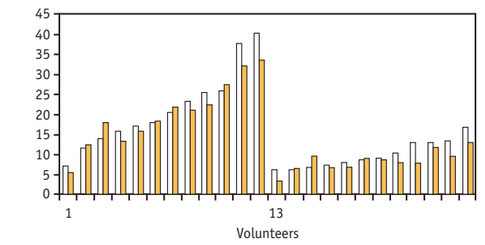


Figure 2: Individual glycaemic responses. The graph shows that the glycaemic responses of individuals differ, but are proportional to GGE units. Glucose responses of subjects 1-12, who had type 2 diabetes were higher than for the others who did not.

The clinical trial was designed by John Monro, Pamela Liu and Tracey Perry and conducted by Pamela Liu at the University of Otago Department of Human Nutrition. Funding was from the Health Research Council of New Zealand. Papers on this research will be published in the Asia Pacific Journal of Clinical Nutrition, and the European Journal of Clinical Nutrition.

New starch

SHOULD PROTECT US AGAINST COLON CANCER

A new starch has been developed that should help protect us against colon cancer. The new starch, called CIActistar, is a resistant starch (resists digestion) and has a fine crystalline structure and prebiotic properties. This means that it enhances bacterial fermentation and thus the production of beneficial butyrate in the colon. CIActstar is a white powder with a bland taste. Cerestar, who developed CIActistar, claim it is suitable for use in a range of bakery products such as bread and biscuits.

"Beyond the GI factor - bread is still the staff of life."