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Development of a Beverage Model to Test Appetite Control Food Ingredients

A thesis presented in partial fulfilment of the requirements for the degree of

Master of Technology

in

Food Technology

at Massey University, Palmerston North, New Zealand

Hui Hsing Irene Ho
2013
The present project is part of the broader ‘Foods for Appetite Control' research programme of Plant & Food Research. The programme aims to deliver validated satiety effects (reduce appetite and provide more than four hours of satiety) in foods through phytochemicals and macro-nutrients. As it is necessary to validate the satiety effects through clinical trials, a beverage model was developed. It served as a ‘vehicle’ for incorporating phytochemicals (e.g. fruit extract) and macro-nutrients (e.g. viscous fibre – alginate) to deliver their satiety effects, which were validated by a satiety measurement trial.

The development work began with the characterization of viscous fibres. Based on the literature review, pectins and alginates appear to be more satiating than other viscous fibres. It is believed that gastric gelation can induce satiety, through the formation of a gel that has some strength (presumably in the stomach). Based on rheological measurements, Protanal® LF120 alginate and Grindsted® Pectin LA410 were selected for further evaluation in the beverage model. These viscous fibres met the criteria of providing viscosity to the beverage, showing sensitivity to acids and calcium ions resulting in gelation, and contributing to higher gel strength than others that were evaluated.

The beverage model was developed as a partial-meal replacer beverage, which is non-dairy, soy protein-based, fruit-flavoured (blueberry), 250 mL and of neutral pH (~7.2). The development work has established a base formulation and processing method for the beverage model and has successfully incorporated Protanal LF120 (0.25% and 0.5%) and fruit extract (0.2%). Due to its low viscosity and poor stability in UHT-processing even at high levels, Pectin LA410 was excluded from further evaluation. Incorporation of quercetin and isoquercetin into the beverage model was unsuccessful because of their insolubility in water and interactions with soy proteins.

A methodology for satiety measurement was established and a trial was carried out to validate the satiety effects (subjective appetite) of the fruit extract and Protanal LF120 in the beverage model. The trial used a preload (6 test beverages), within-subject (n = 12), repeated measures, completely balanced, crossover and randomized design. The satiety effect of Protanal LF120 was found to be dose-dependent; higher alginate level significantly increased the satiety effect of the beverage. Differences in mean appetite
ratings \((P < 0.05)\) between low and high alginate levels were 6.9\%, 8.3\%, 10.6\%, 6.3\% and 6.7\% for hunger, fullness, satiety, desire to eat and prospective food consumption ratings, respectively.

On the other hand, the data did not reveal statistically significant results across all appetite scales (except for hunger, \(P = 0.015\)) between beverages with and without fruit extract. In addition, the interaction of alginate\(^*\)fruit extract was not statistically significant, implying that the higher satiety effect of the high level alginate \(+\) fruit extract beverage could be purely due to the alginate. Further testing is warranted: (1) to incorporate higher levels of fruit extract in the beverage model to evaluate any dose-dependency, (2) to determine if an additive or synergetic satiety effect exists with a higher level of fruit extract and high alginate level in the beverage, and (3) to modify the current experimental design to increase power of the study to 80\% by increasing the number of subjects.
Acknowledgements

This project is funded by the New Zealand Ministry of Business, Innovation and Employment (MBIE) through the ‘Foods for Appetite Control’ research programme. I would like to acknowledge the administrative, operational and other support provided by The New Zealand Institute for Plant & Food Research Ltd (PFR) and The Institute of Food, Nutrition and Human Health (IFNHH) of Massey University.

I would like to express my deepest gratitude and sincere thanks to my supervisors, Dr. Lara Matia-Merino (IFNHH) and Dr. Lee Huffman (PFR), for their valuable advice, guidance, support and encouragement throughout the project. It has been a very enriching and enjoyable project journey with them.

There are many helpful professionals who have kindly supported the project work, in one way or another. Sincere thanks to (Ms./Mrs./Mr./Dr.) Garry Radford, Warwick Johnson, Michelle Tamehana and Steve Glasgow of IFNHH; Duncan Hedderley, Virginia Corrigan, Claire Redman, Shiji Nair, Sarah Eady, Kevin Sutton, Chrissie Butts, Carolyn Lister, Carl Massarotto and Michelle Hopson of PFR; and Paul Ginn of Sanitarium. The prompt organization of ingredients by many suppliers is highly appreciated; they include Graeme Nealie (Hawkins Watts), Derek Horne (DuPont Nutrition and Health), Sarah Brodrick (GS Hall), Friederike Socik (Salkat) and Clinton Meharry (Sherratt).

A very big THANK YOU to all participants of the satiety measurement trial, the trial will not be possible without their enthusiasm and helpfulness. Participants who have consented to be acknowledged are (Ms./Mrs./Mr./Dr.) Sheridan Martell, Marian McKenzie, Greg Sawyer, Carl Massarotto, Belinda Diepenheim, Sue Middlemiss-Kraak, Hannah Smith, Lei Wang, Robert Simpson, Mareike Knaebel, Siva Sivakumaran, Huaibi Zhang and Kerry Bentley-Hewitt.

Last but not least, special thanks to Ms. Esther Chong for her company, encouragement and support during hectic times of the project.
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