Appetite 62 (2013) 84–90

Contents lists available at SciVerse ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

Research report

Acute effects of a herb extract formulation and inulin fibre on appetite, energy intake and food choice ☆

J.A. Harrold *, G.M. Hughes, K. O'Shiel, E. Quinn, E.J. Boyland, N.J. Williams, J.C.G. Halford

Kissileff Laboratory for the Study of Human Ingestive Behaviour, Department of Experimental Psychology, Institute of Psychology, Health and Society, University of Liverpool, Eleanor Rathbone Building, Bedford Street South, Liverpool L69 7ZA, UK

ARTICLE INFO

Article history:
Received 21 February 2012
Received in revised form 14 November 2012
Accepted 22 November 2012
Available online 1 December 2012

Keywords:
Appetite
Food intake
Food choice
Fibre
Inulin
Herbal
AUC appetite analysis

ABSTRACT

The impact of two commercially available products, a patented herb extract Yerbe Maté, Guarana and Damiana (YGD) formulation and an inulin-based soluble fermentable fibre (SFF), alone or in combination, on appetite and food intake were studied for the first time in a double blind, placebo-controlled, cross-over design. 58 normal to slightly overweight women consumed a fixed-load breakfast followed 4 h later by an *ad libitum* lunch. They were administered YGD (3 tablets) and SFF (5 g in 100 ml water), YGD and water (100 ml), SFF and placebo (3 tablets) or water and placebo 15 min before meals. Appetite was assessed using visual analogue scales, and energy intake was measured at lunch. Significant reductions in food intake and energy intake were observed when YGD was present (59.5 g, 16.3%; 112.4 kcal, 17.3%) and when SFF was present (31.9 g, 9.1%; 80 kcal, 11.7%) compared with conditions were products were absent. The lowest intake (gram and kcal) was in the YGD + SFF condition. Significant reductions in AUC hunger and AUC desire to eat were also observed after YGD + SFF combination. The data demonstrate that YGD produces a robust short-term effect on caloric intake, an effect augmented by SFF. Caloric compensation for SFF indicates independent effects on appetite regulation.

Introduction

The mechanisms underpinning appetite expression are a key target for products designed to control energy intake and marketed to suppress hunger or sustain fullness. The within-meal process of satiation and the post-meal end state of satiety are generated by the sensory, physical and chemical characteristics of the food consumed. The strength of these signals determines meal duration and meal size and/or the length of the post-meal interval before the next eating occasion (Blundell, 1991) and thus they are legitimate targets for appetite control. Many products available to the consumer, including herbal extracts and fermentable fibres, claim to affect appetite through impacting on such mechanisms but supporting evidence ('proof of concept') is limited.

Rodent studies and consumer data indicate that certain herbal extracts may have beneficial effects on appetite and weight control when used as supplements or food components (Ruxton & Gardner, 2005). One such product is a preparation containing extracts of Yerba Maté, Guarana and Damiana (YGD). Andersen and Fogh (2001) found that YGD induced significant weight loss over 45 days compared with control in overweight patients, reducing the time to perceived gastric fullness. YGD also significantly delayed gastric emptying. Consumer studies have also indicated the weight loss (self-reported) and appetite suppressing (retrospective measures) potential of YGD but most of these studies lacked control conditions (Ruxton, 2004; Ruxton, Hinton, & Evans, 2005; Ruxton, Kirkwood, McMillan, St. John, & Evans, 2007). The suggested mechanism of action, based on three studies, is a post-meal delay in gastric emptying which may enhance satiation and strengthen early meal satiety (Andersen & Fogh, 2001; Savage, Adrian, Carolan, Chatterjee, & Bloom, 1987; Schjoldager, Mortensen, Christiansen, Orskov, & Holst, 1989). However, with multiple potentially active components (Yerba Maté, Guarana and Damiana) the mechanisms of action for YGD on energy balance could be numerous. To date, the effects of YGD on human food intake and the flux of appetite between meals have yet to be demonstrated in an appropriate design.

Some fibre types increase satiation and early post-meal satiety through their high viscosity and bulking effects (Burton-Freeman, 2000). Others may affect longer-term appetite control through colonic fermentation and the production of Short Chain Fatty Acids (SCFAs; Bosch et al., 2009). Inulin and inulin-type fructans, mostly oligosaccharides or oligofructoses, stimulate colonic production of

☆ *Acknowledgements*: This work was supported by Natures Remedies Ltd., Amersham, UK. Jason C.G. Halford has also acted as a consultant for the company. Joanne A. Harrold and Jason C.G. Halford participated in the study design, in the analysis and interpretation of the data and writing of the manuscript. Joanne A. Harrold, Katy O'Shiel, Etaoin Quinn, Georgina M. Hughes, Emma J. Boyland and Nicola J. Williams were involved in performing the studies and writing the manuscript.

* Corresponding author.
E-mail address: harrold@liverpool.ac.uk (J.A. Harrold).

0195-6663/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.appet.2012.11.018

SCFAs (Guarner, 2005) with effects on food intake typically only reported after a duration sufficient for complete fermentation of the fibre to occur (Archer, Johnson, & Devereux, 2004) or after repeated dosing (Cani, Joly, Horsmans, & delzenne, 2006; Delzenne, Cani, Daubioul, & Neyrinck, 2005). Prolonged (3 weeks) treatment with inulin-type fructans has been shown to reduce plasma ghrelin levels and increase intestinal gene expression and secretion of glucagon-like peptide-1 (7–36) amide (GLP-1; Cani, Dewever, & Delzenne, 2004; Delzenne et al., 2005). Inulin may therefore reduce hunger and the consumption of palatable food via ghrelin mediated mechanisms (Egecioglu et al., 2010; Jerlhag et al., 2007) and/or strengthen satiety by a GLP-1 mediated delay of gastric emptying (Hellström et al., 2008; Roberfroid, 2007). However, despite plausible mechanisms, evidence for the effects of inulin and inulin-type fructans (acute or chronic), on human food intake, food choice, eating behaviour and subjective feelings of appetite remains equivocal (Archer et al., 2004; Peters, Boers, Haddeman, Melnikov, & Qvyjt, 2009). Nonetheless, we have recently observed acute effects of these fibre types on appetite ratings in preload designs (unpublished results). Although such acute studies are not sufficient to support satiety claims per se as evidence of prolonged efficacy is required, they do provide valuable proof-of-concept data.

The current study is the first to assess the acute impact of two products, both with purported effects on gastric emptying, appetite expression, caloric intake and food choice. A patented herb YGD formulation and an inulin-based soluble fermentable fibre (SFF) were tested alone and in combination. SFF used in this acute study (Fibresure) was selected based on previously observed effects on appetite (unpublished) in a study administering the same fibre prior to a fixed load meal. Products were given prior to a fixed load breakfast to determine if they strengthened post-meal satiety and prior to lunch to determine their effects on satiation. Based on existing data it was hypothesised that the products would (1) produce a significant reduction in food intake at a subsequent *ad libitum* test meal, (2) produce a specific reduction in the intake of high fat palatable foods at this meal and (3) impact on pre-and post-meal appetite ratings indicating enhanced satiety. Given the potential role of fermentation in the effects of the fibre on appetite, changes in appetite were observed for up to 8 h after the first dose. With the potential for additive or synergistic effects on gastric emptying it was also proposed that the observed effects on appetite would be enhanced through co-administration of these products. Such proof-of-concept studies are necessary prior to examining efficacy (enduring effects on appetite and weight control) and other consumer benefits in the intended populations.

The current study also adopted a new proposed standard in analysing appetite ratings. The AUC ANCOVA analysis has been proposed as superior to standard time by condition ANOVA analysis of VAS because the latter approach does not take into account that appetite ratings are a function of multiple time points which are not physiologically or statistically independent. Additionally this alternative approach negates the inflation of type 1 statistical errors which occurs with comparisons of multiple single time points and which can lead to inappropriate conclusions regarding product efficacy (Blundell et al., 2010).

Methods

Participants

A population of likely consumers of the products (normal and overweight women) were recruited to the study. Fifty-eight healthy women, aged 18–65, with a body mass index (BMI) between 18.5 and 29.9 kg/m^2 completed the study. Volunteers were recruited by advertisement from the University of Liverpool and surrounding area of Merseyside in England. Individuals completed a standardised telephone or email assessment to determine their eligibility for the study. Those who were aged over 65, with a BMI <18.5 kg/m^2 or >29.9 kg/m^2, who disliked more than 25% of the *ad libitum* lunch study foods, were smokers, currently dieting, or who did not eat regular meals were not studied further.

Screening

Following the initial telephone/email assessment, potential participants received detailed information on the protocol, and were invited to the study centre for a full screening no more than 21 days before commencing the study. All volunteers provided informed consent before any study-specific procedures were undertaken. Confidentiality and anonymity were assured. The protocol and study forms were approved by the University of Liverpool Committee on Research Ethics. The study conformed to the British Psychological Society Code of Practice and was also in line with the relevant sections of the Declaration of Helsinki. Volunteers received financial compensation for their participation.

At the screening, height was measured without shoes, using a stadiometer to the nearest cm and weight was verified using standard calibrated scales to the nearest 0.1 kg. Participants also completed a medical history, diet history, and the restraint subscale of an eating behaviour questionnaire (The Dutch Eating Behaviour Questionnaire [DEBQ-R]; van Strien, Frijters, Bergers, & Defares, 1986).

Exclusion criteria

Following screening, participants were excluded from the study if they reported any of the following: significant health problems; having dieted in the last 12 months to lose or control weight; current adherence to a specific food avoidance diet; gastrointestinal symptoms requiring treatment; bariatric surgery; systemic or local treatment likely to interfere with evaluation of the study parameters; taking medication known to affect appetite or weight; being pregnant or planning to become pregnant or breastfeeding; history of anaphylaxis to food; general or specific food allergies, including caffeine and any of the study foods; dislike of more than 25% of the *ad libitum* study foods; extreme dietary restraint (>2 standard deviations from the DEBQ-R mean). Women who were employed in nutrition, dietetics, food research, food manufacturing or the food supplements industry were also excluded from the study. Those participants who fulfilled the study criteria were recruited to the study and assigned a code number.

Study design

The study was single-blinded and utilised a randomised within-subject design to evaluate the effects of YGD and SFF given together or separately against a placebo control. However, a fully controlled design was not employed as the energy content of SFF (25.4 kcal) was not matched in the placebo. This reflects the difficulty in identifying a suitable product with similar sensory characteristics but containing rapidly digestible calories. Consequently, the study relied upon analysis of intake data to determine whether participants compensated for the consumption of additional calories in the SFF conditions. Each study treatment was separated by 48 h and participants were randomised to the study by means of a block plan created on an internet programme (www.randomization.com). The effects of the study products on post meal satiety were determined after a fixed load breakfast and the effects on satiation were identified at an *ad libitum* lunch. Appetite was further measured across the afternoon to detect any effects of fermentation. Sample size