Appetite 54 (2010) 282–288

Contents lists available at ScienceDirect

Appetite

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

Research report

Chickpea supplementation in an Australian diet affects food choice, satiety and bowel health

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ARTICLE INFO

Article history:
Received 24 February 2009
Received in revised form 1 October 2009
Accepted 20 November 2009

Keywords:
Chickpea
Legume
Focus group
Food group
Satiation
Diet
Chronic disease

ABSTRACT

The study aimed to examine both changes in food consumption, satiation and perceived bowel health while consuming a diet rich in chickpeas, and participants, feelings about the dietary change. Forty-two participants completed an ordered crossover study, consuming their habitual diet for 4 weeks, a chickpea supplemented (average 104 g/day) diet for 12 weeks, and their habitual diet for another 4 weeks. Weighed dietary records were quantitatively analysed for changes in consumption of foods from within eight food groups. Perceived changes to bowel function and satiation were semi-quantitatively assessed using anchored visual analogue scales. Focus groups were used to qualitatively explore the acceptability of chickpea consumption and the benefits of, and barriers to, legume consumption for 15 participants. Intake of foods from all food groups was lower during the chickpea supplemented phase, particularly foods of the Cereal food group ($P = 0.01$). Participants tended to eat more processed snack foods (high energy, low fiber) after ceasing chickpea consumption ($P = 0.09$), a trend supported by focus group discussion. Perceived satiation increased while participants consumed chickpeas and perceived bowel function improved. Health benefits, increases in dietary variety and satiation with legume consumption were the main perceived benefits, while inconvenience and gastrointestinal upset discouraged legume consumption.

Introduction

Consumption of a balanced diet is important for prevention of many lifestyle related chronic diseases. A balanced diet can lower risk factors for coronary heart disease (CHD) and cancer and can aid management of diabetes (Anderson & Major, 2002; Bazzano et al., 2001; Geil & Anderson, 1994; Venn & Mann, 2004; Wahlqvist, 2001). In 1990, the World Health Organization recommended consuming at least 30 g of legumes, nuts and seeds per day to aid the prevention of chronic disease (WHO, 1990). Research has shown legume consumption can lead to beneficial changes in the nutrient composition of the diet, including a significant increase in fibre consumption and significant decrease in saturated fat intake (Oosthuizen, Scholtz, Vorster, Jerling, & Vermaak, 2000). Frequent legume consumption is likely to have a significant beneficial effect on CHD risk by reducing serum total cholesterol, low-density lipoprotein cholesterol and triglyceride levels (Anderson & Major, 2002). Legumes have also been linked with a decrease in the risk of cancer (Adebamowo et al., 2005) and with the prevention and treatment of type 2 diabetes mellitus (Venn & Mann, 2004).

Despite a growing interest in their health benefits, legume consumption in Australia, at 9.8 g/day, is lower than in many other countries (MacLennan, Gottsschall-Pass, & Larsen, 2004). Lack of public knowledge about their health benefits and how to prepare legumes are common reasons cited for this (Lacey, 2004), in addition to perceived increased flatulence due to their metabolism in the large intestine (Messina, 1999).

Chickpeas (*Cicer arietinum* L.) are a staple food in large parts of the world, but less is known about their potential health benefits than for other legumes. Chickpea consumption has been shown to lower serum total cholesterol levels (Ghorai, Mandal, Pal, Pal, & Saha, 2000; Mathur, Khan, & Sharma, 1968), potentially lowering CHD risk. A chickpea rich diet has been reported to result in beneficial changes in food choices and nutrient intake. Consumption of 140 g/day cooked, drained canned chickpeas and chickpea flour foods for 6 weeks resulted in a significant increase in dietary fibre intake in 19 healthy middle-aged volunteers (Nestel, Cehun, & Chronopoulos, 2004). The researchers attributed the significant decrease in saturated fatty acid and cholesterol intake to a shift in food choices due to the effects of chickpeas on satiation levels but these changes were not quantitated. Advances in understanding of the metabolic interactions that govern energy balance, appetite and body weight have increased interest in the effects of diet on satiation (degree of fullness leading to meal cessation) and satiety (interval between cessation of one meal and initiation of the next)

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doi:10.1016/j.appet.2009.11.012

(Holt, Miller, Petocz, & Farmakalidis, 1995; Riccardi et al., 2004; Yao & Roberts, 2001). Satiation may be reached faster, and satiety last longer, after consuming foods with a higher content of dietary fibre/complex carbohydrate. High-fibre foods are bulkier and take longer to eat than lower-fibre foods (Howarth, Saltzman, & Roberts, 2001; Marlett, McBurney, & Slavin, 2002) and delay gastric emptying (Blackwood, Salter, Dettmar, & Chaplin, 2000; Howarth et al., 2001; James, Muir, Curtis, & Gibson, 2003). Increased consumption of higher fibre foods has been associated with improved bowel health and stool consistency (Cummings et al., 2004; Dahl, Whiting, Healey, Zello, & Hildebrandt, 2003; Tharanathan & Mahadevamma, 2003).

Studies have reported nutrient changes that occur in a 'usual' Australian diet supplemented with chickpeas (Nestel et al., 2004; Pittaway et al., 2004; Pittaway, Robertson, & Ball, 2008) but there are currently no published studies investigating the foods chickpeas replaced. Oosthuizen et al. (2000) investigated changes in consumption of selected foods (eggs, chicken, red meat, brown bread, white bread, breakfast cereals, porridge, vegetables and fruit) in participants consuming 91.9 g/day of extruded dry beans. The participants were instructed to replace carbohydrate rich foods with beans and complied by replacing bread and breakfast cereals. In the current study, participants were required to consume a chickpea supplemented ad libitum diet but were able to freely exercise their own dietary choices.

The current study had three main aims: to quantitatively assess the impact of chickpea supplementation on the composition of a 'usual' Australian diet; to increase understanding of why chickpea/legume consumption is so low in Australia and to help build strategies aimed at increasing consumption. Food consumption during a 12-week chickpea supplemented ad libitum diet was quantitatively assessed and compared to food consumption during a 4-week period of habitual ad libitum diet. A semi-quantitative assessment of perceived bowel function and satiation was also included. Chickpea/legume acceptability was gauged through the use of qualitative focus group research to test popular perceptions and to complement the literature.

Methods

Ethical approval and funding of research

Ethics approval for the study was granted by the Northern Tasmanian Health and Medical Human Research Ethics Committee (application number H0007926) and the study has been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki. Funding for the research was provided by the Grain Research Development Corporation (GRDC) and canned chickpeas were provided by Simplot (Australia).

Participants

Male and female participants aged between 30 and 70 years from Northern Tasmania were recruited via local media. The age range was decided upon because cardiovascular disease (CVD) increases with age and to include both pre and postmenopausal women. In addition, this wide age range allows for a variety of habitual diets (middle aged and working and/or with families versus older and retired without families) and a variety of gastrointestinal responses (more sensitive to dietary change versus less sensitive) to better extrapolate the potential effects of ad libitum dietary chickpea substitution to the general adult population of Northern Tasmania.

Potential participants were questioned via phone interview and successful participants completed a general health questionnaire that included questions about the inclusion and exclusion criteria. Inclusion criteria were age and the presence of one or more CVD risk factors (e.g. high blood cholesterol, overweight), and/or a parent or sibling diagnosed with heart disease, type 2 diabetes mellitus or CVD risk factors. Individuals taking medication to control hypercholesterolaemia or hyperglycaemia or already consuming legumes in more than two meals per week were excluded. Participants were required to give signed, informed consent and were free to leave the study at any time. There was no financial compensation for participation.

Experimental design

The study followed an ordered crossover design in three phases. First, participants consumed their habitual diet for 4 weeks. Second, participants consumed a chickpea supplemented ad libitum diet, consisting of a minimum of four 300 g cans of chickpeas (Edgell, Simplot, Australia) per week, for 12 weeks. Third, the chickpea phase was followed by another 4 weeks of habitual diet. In crossover studies each participant receives two or more treatments in sequence, and then the outcomes in the same participant are contrasted. This means that any influence of participation characteristics can be 'subtracted out' of the treatment comparisons. The crossover design can therefore produce statistically and clinically valid results with fewer numbers of participants than is required for other study designs (Louis, Lavori, Bailar, & Polamski, 1984).

The study provided the cans of chickpeas and a wide selection of recipes, to equip participants with a variety of examples and alternatives for chickpea consumption. No advice was given to the participants regarding chickpea food exchange; they were allowed to make their own adjustments, as befitted observation of the consequence of chickpea supplementation of habitual ad libitum diets.

Participants attended clinical facilities five times during the study at the University of Tasmania, Launceston, or Clifford Craig Medical Research Trust, Launceston General Hospital. They attended at the beginning of the study, the end of first habitual dietary phase (CP1), prior to commencing the chickpea phase (H1), halfway through the chickpea phase, the end of the chickpea phase (CP2) and the end of the second habitual dietary phase (H2). All participants were contacted via telephone or email, once per week during the chickpea phase and once per fortnight during the habitual phases, to maintain compliance and address any concerns. Participants were queried on the amount of chickpeas they were eating per day and how they were incorporating them into their daily diet. If participants were using recipes other than those distributed at the commencement of the chickpea phase, copies of the recipes were obtained and passed on to other interested participants.

Dietary assessment and analysis

Participants were provided with a dietary booklet containing instructions for weighing food and completing diet diaries, dietary record sheets, and photographs of common meal servings. Participants were also verbally instructed on how to complete a diet record at an information session at the commencement of the study and encouraged to contact the researcher between appointments if further clarification was required. The researcher checked the diet records with participants at each appointment, eliciting clarification where necessary.

Four-day dietary records were completed in the final week of the habitual dietary phases. Participants were instructed to record their food intake during two weekdays and two weekend days and the day and date of entries was recorded. These were checked by the researcher at each appointment. Seven-day dietary records