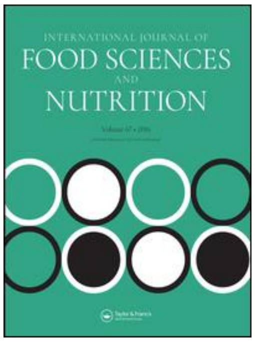


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RESEARCH ARTICLE



# Effects of cereal bar containing polydextrose on subjective feelings of appetite and energy intake in overweight adults over 15 d

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**ABSTRACT**

The effects of 15 d polydextrose (16.7 g) consumption on energy intake (EI) and appetite feelings were investigated. Overweight adults consumed a polydextrose-bar or a control-bar matched in energy content as a midmorning snack for 15 consecutive days in a single-blind, randomised, crossover design. The two 15-d intervention periods were separated by a 15-d washout period. On the day 1 and the day 15 of each intervention period, energy intake (primary outcome) and appetite feelings (secondary outcome) were assessed. There were not significant main effects of the day, type of bar, or their interaction for EI (at lunchtime test meal, at rest of the day, or at total daily) or subjective feelings (hunger, desire to eat, fullness, and prospective food consumption) during the satiation and satiety periods. The results showed the consumption of polydextrose-bar during 15 d did not significantly affect energy intake and subjective feelings of appetite in overweight adults.

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Polydextrose; cereal bar; appetite; energy intake

## Introduction

The negative health, social, and economic consequences stemming from the prevalence of overweight and obesity have led to a focus on the promotion of food intake restriction and dieting behaviour as the primary means to manage body weight (Booth 2011; Shill et al. 2012). Evidence shows that a high intake of dietary fibre supports the regulation of energy intake and satiety and could contribute favourably to the fight against obesity. However, fibre intake is lower than recommended fibre intake for adult population (25 g/d in women and 38 g/d in men) (Delargy et al. 1997; Kristensen and Jensen 2011; Harrold et al. 2014; Ho et al. 2015).

Polydextrose (PX) is a soluble non-viscous man-made polymer, widely used as an additive for more than 15 years. It is not digested in the upper gastrointestinal tract, but it is partially fermented by the gut microbiota (Raninen et al. 2011). It is recognised as a dietary fibre (FAO/WHO 2009), and also has positive organoleptic properties that would foster its incorporation into a variety of foods. Diverse studies have shown PX reduces energy intake at a subsequent meal, especially when administered as part of a mid-morning preload (12–25 g) before an *ad libitum* lunch (Hull et al. 2012; Astbury et al. 2013; Ranawana et al. 2013). Nevertheless, Ibarra et al. (2017) did not find that effect.

Satiation and satiety describe the feelings that lead to cessation of a meal and inhibit the desire to eat between meals. Both sensations are regulated by a multitude of environmental, central, and peripheral signals (Blundell et al. 2010). Regarding the effects of PX consumption on subjective feeling of satiety, different results were reported. Some studies did not find effects on subjective ratings of hunger, fullness, desire to eat, and prospective food consumption (Astbury et al. 2013; Ranawana et al. 2013), while others only find a decrease in hunger (Olli et al. 2015) and prospective consumption (Hull et al. 2012).

Most experiments on the effects of foods on satiation or satiety consist of a single administration of a preload on a single occasion. Taking into account the outcome of one single exposure of a food, it is often inferred that such an effect would be observed on all future occasions if the food is continued administered on a daily basis (Blundell et al. 2010). However, for a food influencing short-term satiety to be successful in

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Supplemental data for this article can be accessed here.

body weight management, reductions in daily energy intake must be sustained when the food is daily consumed (Halford and Harrold 2012; Astbury et al. 2014). There are few examples in which this has been done. King et al. (2005) assessed the effects of xylitol and PX included in yoghurt on hunger and energy intake over 10 d. Cani et al. (2006) assessed the effects of oligofructose included in beverage on satiety and energy intake in humans over 2 weeks. Guérin-Deremauxa et al. (2011) studied the effect of different dosages of dietary supplementation of commercial fibre (Nutriose) included in orange juice over 3 weeks.

Most studies tested the effects of fibres supplied in beverages at midmorning. Astbury et al. (2014) tested a solid food with combination of high dose of whey protein and low dose of polydextrose in a snack bar. In a previous study, we investigated the effects of a pudding containing 12.9 g whey protein and 6 g PX in healthy people (Martinelli et al. 2017). Other studies tested a solid food including other fibres in cookies, bread, and muffins (Isaksson et al. 2009; Willis et al. 2009; Wanders et al. 2011) but satiety evaluation was always made in short term.

The primary outcome of this study was to evaluate whether there are effects on EI when PX-bars are consumed on a daily basis over 15 d by overweight adults. The secondary outcome was to investigate the effects of the consumption of snack bars on subjective appetite feelings.

## Materials and methods

### Investigational product

Cereal bar was selected as an appropriate food to which higher doses of PX could be added without noticeable changes in its sensory properties. They were prepared using cereal mix (Nestlé™ Argentina), sunflower oil (Natura™, ADG alimentos naturales, Argentina), egg white, glucose, whey protein concentrate (WPC-80) containing 76 g protein/100 g (Arla Foods SA, Buenos Aires, Argentina) and a commercially available PX containing 90 g fibre/100 g (Baolingbao Biology CO. LTD, Beijing, China).

Two kinds of isoenergetic bars were formulated. The formula of polydextrose added bar (PX-bar) per 100 g was 38.2 g cereal mix, 37 g PX, 11.6 g glucose, 8.6 g WPC, 4.6 g sunflower oil. The formula of control bar (C-bar) (100 g) was 54.1 g cereal mix, 19.1 g egg white, 11.6 g glucose, 6.4 g WPC, 4.5 g sunflower oil, 4.3 g PX. Cereal bars were prepared by mixing dry ingredients with liquid ingredients for 3 min. After that, the mix was put into plates, compressed in order to mould the product, and baked in an oven at 130 °C for 20 min. Once baked, cereal bars were cooled down to room temperature, cut into portions, and packed in polyethylene bags. Cereal bars were prepared two times per week.

**Table 1.** Nutritional composition of the portion of polydextrose and control bars.

| | PX-bar (50g) | C-bar (44g) |
|---|---|---|
| Energy (kJ) | 626 | 612 |
| Protein (g) | 4.6 | 4.7 |
| Available carbohydrate (g) | 19.5 | 22.4 |
| Fat (g) | 4.0 | 4.0 |
| Total fibre | 17.7 | 2.5 |
| Polydextrose (g) | 16.7 | 1.7 |
| Protein (% of energy) | 12.2 | 12.8 |
| Available carbohydrates (% of energy) | 52.4 | 61.4 |
| Fat (% of energy) | 24.2 | 24.6 |
| Polydextrose (% of energy)[a] | 11.2 | 1.2 |

PX-bar: polydextrose bar; C-bar: control bar.
[a]For polydextrose, 4.2 kJ/g was used as the energy value.

To ensure both products were matched for energy content, a larger serving of the test product (50 g versus 44 g for the control) was given. The nutritional composition of test and control cereal bars by tested portion size is shown in Table 1.

### Participants

Before inclusion in the study, potential participants were briefed on all aspects of the experiments and given the opportunity to ask questions. Inclusion criteria for volunteers were weight stable (<3 kg change in body weight in previous 6 months), body mass index (BMI) between 25 and 29.9 kg/m$^2$, habitually consuming breakfast (≥5 d/week), non-smokers, not partaking in sports at the competitive and endurance levels, not having allergies/intolerances or particular dislike of any of the foods provided during the study, with no current diseases, and not currently taking any medications. Females were not pregnant or lactating. Participants were selected to be unrestrained eaters as defined by a score of <9 on the eating restraint section of the Three-Factor Eating Questionnaire (Stunkard and Messick 1985). All participants were recruited and studied between May 2016 and March of 2017. Approval for the study was obtained from the Ethics Committee of the School of Biochemistry, Universidad Nacional del Litoral, Santa Fe, and a written consent was given by all volunteers.

Anthropometric measurements were obtained in the fasting state with the participant wearing light clothes according to the rules of the International Society for the Advancement of Kinanthropometry (Society International for the Advancement of Kinantropometry – ISAK). Height was measured to the nearest centimetre using a freestanding stadiometer with the subject standing erect and the head in the Frankfurt plain. Body weight was measured to the nearest 0.05 kg using calibrated anthropometric weighing scales (CAM, Buenos Aires, Argentina). BMI was calculated as weight (kg)/height$^2$ (m).

### Study design

This pilot study was a single-blind, randomised, crossover trial, placebo-controlled that spanned a total of 45 d. Two 15-d intervention phases were separated by a 15-d washout period. Participants made four experimental visits to the laboratory, which were scheduled on the first (day 1) and last (day 15) days of each intervention period. The aim of the study and the content of the cereal bars were not made known to the participants.

### Procedure

The assessment schedule per visit corresponding to first and second intervention period is shown in Table 2. During the first intervention period, participants remained free-living, and the diet content was self-selected. However, subjects were instructed to consume the cereal bars each day as a between-meal, midmorning snack. Cereal bars were given to participants twice a week in the place indicated by them. After participants had completed the first intervention period, they were instructed to consume their regular diet for 15 d (no snack bars were provided for consumption) as a wash-out phase. During the second intervention period (15 d), participants were provided with the alternative cereal bar. The order in which participants received cereal bars was randomised and counterbalanced. On the 5th and the 9th day of each intervention phase, participants were asked to record all foods and drinks consumed for a 24-h period in a food diary (Ortega et al. 2015). Participants were asked to warn about any adverse effects and any medication they needed to take during the study.

### Experimental laboratory protocol

The participants followed a partly free living protocol. They arrived at 08:00 h following an 11 h overnight fast to be provided with the fixed breakfast (milk, toast, cracker, cheese spread, and jam). Volunteers were instructed to consume an amount of food similar to their habitual breakfast on the first test day, and this amount was then fixed for each subsequent test day. Therefore, the energy and nutrient content of the breakfast was individually standardised and fixed for each of the two conditions. Then, participants were allowed to leave the laboratory to conduct their occupation elsewhere. Volunteers were instructed to consume investigational or control products at 10:30 h and not to consume any other food or drink during the breakfast–lunch interval. At 12:30 h subjects returned and were provided a pizza lunch to consume *ad libitum* and a bottle of water (500 mL). Volunteers were given 30 min to consume the meal and were instructed to eat only until they were comfortably full. Conversation was allowed with the exception of discussing the study or comparing ratings. Cheese pizza was selected because (1) its nutrient distribution is uniform, thus the energy intake (EI) estimation is facilitated; (2) it is easily prepared with minimal variation between batches; (3) it is well liked by the subjects as determined in the subject recruitment session (Zafar et al. 2013). Pizzas of 10 cm diameter were offered in excess to minimise external food cues. The cooked pizzas were weighed before serving and uneaten portions were subtracted from the initial weight to provide a measure of energy intake. Each

**Table 2.** Assessment schedule per visit corresponding to first and second intervention period.

| Assessments | Screening Visit 1 | Intervention period (1) Visit 2 Day 1 | Intervention period (1) Visit 3 Day 15 | Washout 15 d | Intervention period (2) Visit 4 Day 1 | Intervention period (2) Visit 5 Day 15 |
|---|---|---|---|---|---|---|
| Informed consent | X | | | | | |
| Inclusion/exclusion criteria | X | | | | | |
| Height, weight and Body Mass Index | X | | | | | |
| Three-Factor Eating Questionnaire | X | | | | | |
| Concomitant medication | X | X | X | X | X | X |
| Randomization | X | | | | | |
| Fixed breakfast | | X | X | | X | X |
| Product administration | | X | X | | X | X |
| VAS | | | | | | |
| *Ad libitum* lunch/energy intake | | X | X | | X | X |
| Food dairy[a] | | X | X | | X | X |

VAS: Visual Analog Scale to assess subjective feelings of appetite.
[a]Additionally, on the 5th and the 9th day of each intervention phase, participants registered food diary.

100 g of the test meal provided 1535 kJ, with 17%, 33%, and 50% of total energy from protein, fat, and carbohydrates, respectively.

### Energy intake

Energy intakes were calculated using compositional data provided by the manufacturers and tables of food composition. The EI for the rest of the day was extracted from food diaries that the volunteers filled after leaving the lab. Total daily EI was calculated by the sum of energy consumed at breakfast, the energy provided by the snack, EI at the *ad libitum* test meal, and self-reported intake for the remainder for the day.

### Subjective feelings ratings

Subjective feelings ratings for hunger, fullness, desire to eat, and prospective food consumption were obtained immediately before and after food consumption (cereal bar and test lunch) and at half hourly intervals between both meals. Additionally, ratings were registered 90 min after lunch.

Appetite was determined based on differences among VAS questions (Visual Analogue Scales) about hunger, desire to eat, fullness, and prospective food consumption (Flint et al. 2000). Each VAS consisted of 100 mm lines anchored at each end with opposing statements. The Motivation to Eat VAS questionnaire used to assess subjective appetite was composed of four questions or scales as follows: (1) How strong is your desire to eat? ("very weak" to "very strong"), (2) How hungry do you feel? ("not hungry at all" to "as hungry as I've ever felt"), (3) How full do you feel? ("not full at all" to "very full"), and (4) How much food do you think you could eat? ("nothing at all" to "a large amount"). Participants were asked to mark their responses by placing a vertical line across the 100-mm horizontal scale. VAS ratings were quantified by measuring in millimetres the distance between the left end of the scale and the marked point. These recommended scales are easily used and translated, and appear to be a valid, sensitive, and unbiased measurement tool for regular use in standard practice (Blundell et al. 2010).

Subjective feelings ratings of hunger, desire to eat, fullness, and prospective food consumption were divided into two periods, namely "satiation" (pre-to post-meal) and "satiety" (postmeal to subsequent meal), and expressed as incremental areas under the curve (iAUC) according to Olli et al. (2015). Appetite rating curves were adjusted to zero intensity at time point 5 min (after the cereal bar consumption). Thus, iAUC for satiation corresponds to the time points starting immediately before consuming the snack (0 min) and continuing 5 min after the snack; and iAUC for satiety corresponds to the time period from after consuming the snack until the initiation of lunch (110 min).

### Statistical analysis

#### Sample size

The sample size of 10 participants was calculated to be able to detect difference in energy intake. Sample size has been used in similar long-term study design investigating changes in energy intake at a lunch time (Cani et al. 2006; Astbury et al. 2014).

#### Energy intake (EI) and subjective feelings of appetite

EI at lunchtime, EI at the rest of the day, total daily EI, and iAUC data were analysed by multifactor ANOVA. Planned post hoc analyses were conducted by using a 2-tailed paired Student's $t$ test to compare differences in these variables between snacks and between study days. Differences were considered significant at $p < .05$.

The incremental areas under the curve (iAUC) for appetite ratings (hunger, desire to eat, fullness, and prospective food consumption) for two periods (satiation and satiety) are reported as mean ± SEM in min mm.

Data were analysed using the Statistical Package for the Social Sciences for Windows (version 17, SPSS Inc, Chicago, IL). All data are presented as means ± SEMs unless otherwise stated.

## Results

Thirty healthy overweight male and female participants between the ages of 21 and 50 years were recruited from the staff and student population of School of Biochemistry, Santa Fe by means of personal communications. Fourteen volunteers fulfilled the inclusion and exclusion criteria. Four participants withdrew after completion of one session for personal reasons unrelated to the study. Therefore, 10 participants (five female and five males) were enrolled onto the study (Table 3). No adverse events were reported during the study; thus, data were analysed from all participants ($n = 10$).

Breakfast energy intake ranged 1129–1965 kJ. Total dietary fibre intake was calculated from food diary of each intervention phase. When consuming C-bar or PX-bar fibre intake ranged 7–16 g/d and 21–32 g/d, respectively.

### *Energy intake at the test meal*

The EI at the *ad libitum* lunch, the EI for the rest of the day, and the total daily EI values are shown in Table 4. There were not significant main effects of the day ($p = .11$; .50; .41), type of bar ($p = .46$; .76; .91), or interaction day × type of bar ($p = .71$; .87; .98) for *ad libitum* EI at lunchtime test meal, EI at the rest of the day, EI at the total daily, respectively.

### *Subjective feelings of appetite*

Results on appetite ratings are presented for hunger (Figures 1 and 2), desire to eat (Figures S1 and S2), fullness (Figures S3 and S4), and prospective food consumption (Figures S5 and S6). All iAUC values of appetite ratings for satiation and satiety periods are shown in Table 5.

**Table 3.** Characteristics of the participants ($n = 10$).

| | Mean | SD | Range |
|---|---|---|---|
| Age (years) | 34.4 | 9.2 | 22.0–50.0 |
| Weight (kg) | 82.2 | 13.3 | 63.5–102.1 |
| Height (m) | 1.74 | 0.12 | 1.62–1.90 |
| BMI (kg/m$^2$) | 28.0 | 1.8 | 25.1–29.8 |
| Restraint score[a] | 4.6 | 2.3 | 2.1–8.2 |

All values are means ± SD. BMI: body mass index.
[a]Restraint was assessed by using cognitive restraint scale of the Three Factor Eating Questionnaire (Stunkard and Messick 1985).

There were not significant effects ($p > .05$) for the type of bar, day, and their interaction on subjective feelings (desire to eat, hunger, fullness, and prospective food consumption) during satiation and satiety periods. However, a marginal effect of type of bar x day interaction for hunger feeling was observed in

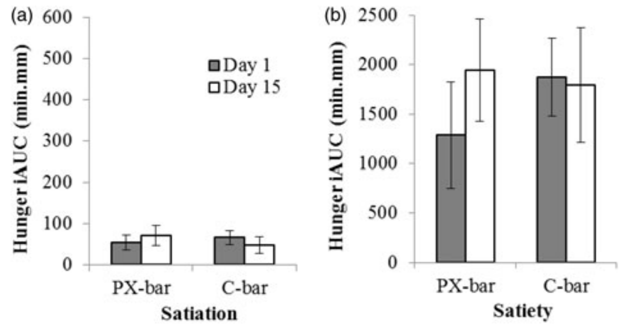


**Figure 2.** Visual analogue scales (VAS) results for the subjective feelings of hunger. The incremental areas under the curve (iAUC) for C-bar and PX-bar at 1 and 15 d (means ± SEM). (a) iAUC during satiation period (between 0 and 5 min). There were not significant main effects of the type of bar ($p = .93$), day ($p = .58$), and interaction ($p = .08$). (b) iAUC during satiety period (between 5 and 110 min). There were not significant effects of type of bar ($p = .40$), day ($p = .62$), and interaction ($p = .07$).

**Table 4.** Energy intake consumed at lunch, rest of the day, and total daily energy intake.

| | PX-bar day 1 | C-bar day 1 | PX-bar day 15 | C-bar day 15 |
|---|---|---|---|---|
| *Ad libitum* lunch energy intake (kJ)[a] | 4173 ± 362 | 4277 ± 305 | 4586 ± 317 | 4791 ± 236 |
| Rest of the day energy intake (kJ)[b] | 4525 ± 444 | 4271 ± 554 | 4225 ± 846 | 4195 ± 433 |
| Protein (% of energy)[c] | 18.3 ± 6.6 | 23.9 ± 5.2 | 16.4 ± 7.8 | 18.1 ± 5.5 |
| Carbohydrates (% of energy)[d] | 39.9 ± 20.2 | 32.8 ± 21.5 | 39.7 ± 11.8 | 44.5 ± 19.2 |
| Fat (% of energy)[e] | 38.5 ± 17.4 | 39.9 ± 18.2 | 35.8 ± 14.3 | 35.6 ± 16.2 |
| Total daily energy intake (kJ)[f] | 10,712 ± 591 | 10,660 ± 543 | 11,114 ± 1099 | 11,030 ± 448 |

All values are means ± SEMs ($n = 10$).
[a,b,c,d,e,f]There were not significant main effects of the day (1 or 15), type of bar (PX-bar or C-bar) or interaction day × type of bar ($p > .05$).

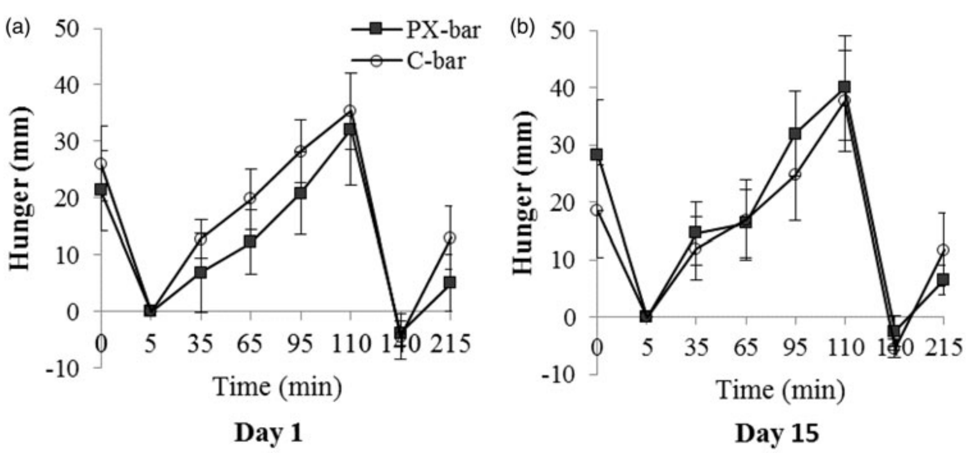


**Figure 1.** Visual analogue scales (VAS) results for subjective feelings of hunger for C-bar and PX-bar. Curves were adjusted to zero intensity at 5 min after bar consumption. (a) VAS curves corresponding to day 1. (b) VAS curves corresponding to day 15.

**Table 5.** Incremental areas under the curve (iAUC) of subjective feelings of satiation and satiety.

| Subjective feeling | PX-bar Day 1 | C-bar Day 1 | PX-bar Day 15 | C-bar Day 15 |
|---|---|---|---|---|
| Hunger[a] | | | | |
| Satiation | 53 ± 18 | 66 ± 16 | 71 ± 24 | 47 ± 20 |
| Satiety | 1284 ± 537 | 1876 ± 395 | 1946 ± 520 | 1795 ± 583 |
| Desire to eat[b] | | | | |
| Satiation | 47 ± 14 | 70 ± 21 | 48 ± 14 | 37 ± 24 |
| Satiety | 976 ± 617 | 1994 ± 528 | 2438 ± 898 | 1414 ± 564 |
| Fullness[c] | | | | |
| Satiation | −77 ± 19 | −64 ± 24 | −66 ± 24 | −69 ± 24 |
| Satiety | −1760 ± 434 | −1561 ± 448 | −1468 ± 433 | −1432 ± 406 |
| Prospective food iconsumption[d] | | | | |
| Satiation | 68 ± 16 | 55 ± 17 | 38 ± 25 | 42 ± 22 |
| Satiety | 2202 ± 401 | 1775 ± 502 | 1583 ± 486 | 2108 ± 420 |

All values are means ± SEMs ($n = 10$). Satiation period (between 0 and 5 min) and Satiety period (between 5 and 110 min).
[a,b,c,d]There were not significant main effects of the day (1 or 15), type of bar (PX-bar or C-bar) or interaction day × type of bar ($p > .05$).

satiation ($p = .08$) and satiety periods ($p = .07$), being lower for consumption of PX-bar at day 1.

## Discussion

It was reported that PX reduce subsequent EI and alters subjective feelings of appetite in a dose-dependent manner (Ibarra et al. 2015, 2016). Most studies have measured the effects on energy intake of PX consumed at midmorning preload (yoghurt or juice) on a single occasion (Hull et al. 2012; Astbury et al. 2013; Ranawana et al. 2013). Moreover, few studies have investigated if PX effects are maintained over the long term (King et al. 2005). However, there is no report of the effects of consumption of solid foods containing PX at levels reported to induce satiety over the long term in overweight adults.

The findings of the present study showed that the average EI at lunchtime meal at day 1 or day 15 was similar between subjects consuming PX-bar or C-bar at midmorning. In contrast, King et al. (2005) showed the consumption of yoghurt with 25 g PX as a midmorning snack reduced subsequent voluntary food intake at the next meal compared with the consumption of control yoghurt, and that effect persist after repeated daily administration (10 d). The higher dose of PX (25 g) used in yoghurt than in bars consumed in our study (16.7 g) may be responsible for decreasing energy intake. Moreover, they evaluated only healthy adults, another difference with respect to our study.

Astbury et al. (2014) tested a combination of whey protein and PX (6 g) in a snack bar at long term. They showed the consumption of this bar as a midmorning snack reduced subsequent voluntary food intake at the next meal compared with the consumption of a control snack containing an equivalent amount of energy but without WP or PX. However, these effects could be attributed to whey protein, since the amount of PX used was very low to induce satiety.

Measuring subjective feelings is a reliable method for analysing the effects of soluble fibres on appetite (Howarth et al. 2001; Ibarra et al. 2016). We determined the levels of subjective feelings of appetite during the satiation (pre-to postmeal, 0–5 min) and satiety (postmeal until subsequent meal, 5–110 min) periods (Martinelli et al. 2017), which allowing us to make meaningful comparisons with previous studies on PX (Olli et al. 2015; Ibarra et al. 2016). At present, we found that PX-bar administered during 15 d, given as part of a midmorning snack, did not produce significant differences in subjective feelings of appetite (hunger, desire to eat, fullness, and prospective food consumption) during the satiation period compared with the consumption of C-bar. The meta-analysis of Ibarra et al. (2016) showed that PX (12.5 g and 15 g) administered on a single occasion reduced desire to eat only during the satiation period, without significant results for the other subjective feelings of appetite.

Regarding satiety period, there was no significant effect of the type of bar or day on subjective feelings (desire to eat, hunger, fullness, and prospective food consumption). The meta-analysis of Ibarra et al. (2016) reported PX (6.3 g, 12.5 g, 16 g, and 25 g) administered on a single occasion did not produce differences on hunger, satisfaction, or fullness during the satiety periods. Olli et al. (2015) reported PX (15 g) reduced iAUC for hunger by 40% at similar dose than our study (16.7 g) during the post-meal satiety period. However, these two studies evaluated the effects of PX on the subjective feelings of appetite at short term.

King et al. (2005) demonstrated that a pre-load of PX (25 g) caused a mild increase in subjective fullness and the effects persisted after repeated daily administration (10 d) in healthy adults. However, they did not calculate iAUC to evaluate subjective feelings and did not consider satiety and satiation periods. They compared individual points of subjective fullness curve, which is not recommended since the full response must be evaluated (Blundell et al. 2010).

Other long-term studies were performed with other fermentable fibres having dissimilar experimental designs and different way of evaluating subjective feelings. Cani et al. (2006) found 14 d treatment with oligofructose (16 g) increased satiety after breakfast and dinner and reduced hunger and prospective food consumption after dinner, suggesting a role for the use oligofructose supplements in the management of food intake in overweight and obese patients. However, they analysed subjective sensations using the VAS without calculating the iAUC. Similarly, Guérin-Deremauxa et al. (2011) studied the impact of different dosages of NUTRIOSE (mixture of soluble fibres) on subjective sensations of appetite during 3 weeks using the VAS without calculating the iAUC. Parnell and Reimer (2009) also administered oligofructose but did not use a crossover design. The participants of this study were randomly assigned to receive 21 g oligofructose/or a placebo (maltodextrin) for 12 week.

We showed the consumption of cereal-bar with 16.7 g PX during 15 d did not significantly affect energy intake and subjective feelings of appetite. In agreement, Willis et al. (2009) found that PX (9.5 g) had limited satiating capabilities compared to other soluble fibres (resistant starch and corn bran). Furthermore, palatability of a fibre-rich food may also play a role. This is not surprising and is supported by a review paper, which reports that palatability of a food (or meal) inconsistently influences appetite and satiety (Sorensen et al. 2003). Highly palatable foods may increase or decrease a person's level of hunger and subsequent food intake and the effects may not be predictable. In this regard, Willis et al. (2009) found that PX in bread was highly palatable and the least satiating with respect to resistant starch and corn bran.

Besides, most studies used beverages as a vehicle, although most dietary fibre is consumed as solid foods in real life. Food matrix may be of importance for the hydration of dietary fibre just as processing of foods affects physicochemical properties of dietary fibre.

Studies generally report more consistent beneficial effects of dietary fibre in acute studies compared with longer ones, indicating that adaptation to a higher intake of dietary fibre may occur or other factors come into play in the long term.

Besides, the baseline fibre intake of the subjects was not controlled. Therefore, it is not known whether habitual fibre intake influenced the results. On the contrary, future studies should also monitor the physical activity of participants during interventions, thus any possible influence of differences in physical activity on outcomes can be excluded (Astbury et al. 2014).

Davy et al. (2007) suggested that limiting the participants to one sex (and specifically males) reduce data variability and errors. However, from a public health perspective, it is important the effects of PX on long-term energy intake and satiety were test on both, females and males.

Despite these limitations, our study demonstrated that a cereal bar containing 16.7 g of PX did not reduce voluntary food intake at a subsequent meal and did not produce differences on subjective feelings of appetite at long term.

## Conclusion

The consumption of a solid food containing 16.7 g PX consumed as midmorning respect to a placebo and during 15 d did not significantly affect energy intake and subjective feelings of appetite in overweight adults. Further studies should be performed to determine if this effect is maintained in other type of solid foods and higher doses of PX. Moreover, other fibres or combinations of fibres could be used to reduce energy intake.

## Disclosure statement

The authors report no conflicts of interest.

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