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Perceived changes in well-being following polysaccharide intake in middle-aged adults.

Abstract

Objectives: There is increased scientific interest in the effects of nutrition on cognition and well-being. Plant sourced polysaccharides play multiple roles in the biological processes required for health and well-being. This study explored the subjective experiential reports of well-being following intake of a plant derived polysaccharide supplement.

Design: The study used a 12 week double-blind, placebo controlled polysaccharide supplementation design.

Method: 109 middle-aged adults (45-60 years) took a standardised teaspoon of a combination of plant polysaccharides or a placebo twice daily for 12 weeks (3.6 g per day), and completed three, open-ended interviews at weeks 4, 8 and 12.

Results: Participants who took the polysaccharide supplement reported significantly more perceived beneficial changes in both physical and psychological well-being, specifically at week 12, compared to those who received the placebo.

Conclusion: This study provides a starting point for understanding the perceived beneficial impact of polysaccharide interventions on aspects of well-being. Importantly, as a health-related application of polysaccharide science, this research supports the relationship that is emerging between the properties and function of polysaccharides. It is essential that future research assesses the effects of polysaccharide intake on a range of physical and psychological well-being outcomes to further the understanding of structure-function relationships with the aim of enhancing the functional health and well-being of individuals.

Keywords: polysaccharides, well-being, middle-aged adults

Introduction

The concept of well-being can be defined as anything that relates to an individual's ability to function well, physically, mentally, emotionally and spiritually. Often replaced by terms such as quality of life, well-being encompasses feeling good physically and psychologically even in the presence of illness and disease (Schickler, 2005). The ability of food components to affect well-being is attracting increasing research attention, with positive effects of nutrition reported for both physical and psychological well-being. For example, micro nutrients such as B vitamins (B1, B2 and B6) and iron have been shown to improve mood (Benton & Donohoe, 1999; Kaplan, Crawford, Field, Simpson, & Steven, 2007). In addition, various nutrients such as omega-3 fatty acids have been associated with better physical health outcomes (Lee, O'Keefe, Lavie, & Harris, 2009). Importantly, plausible biological mechanisms by which certain nutrients affect physical and psychological well-being are beginning to be understood.

One nutritional component that is emerging as a significant mediator of biological mechanisms that contribute to human health are polysaccharides. As a group, polysaccharides are complex carbohydrate compounds found primarily in plants (e.g., vegetables and fruit), algae and fungi (Warrand, 2006).Traditionally, polysaccharides have been used as thickening, emulsifying and stabilising agents in food. However, for centuries a number of cultures have used polysaccharide-rich plants and fungi, such as aloe and mushrooms, for therapeutic effects. In general, saccharide compounds derived from natural sources are structurally diverse and can contain as much as ten different monosaccharide sugars, such as mannose, galactose, fucose, glucose and arabinose. Importantly, the diversity in the origins of polysaccharides and the structural size of the molecules suggests that the physiochemical properties of polysaccharides influence a broad range mechanisms that impact biological processes required for health, such as cell-to-cell signalling events (Leung, Liu, Koon, & Fung, 2006; Stella, Service, & Schurmi, 2001). Thus, there is broad scope to determine potential, functional health outcomes of polysaccharides in terms of subjective changes in overall well-being, both physical and psychological.

At present, the biological properties and mechanisms of action of polysaccharides are being explored for their positive effect on human health and well-being. For example, saccharides are emerging as significant immune modulating molecules that are important for overall healthy function (Schepetkin & Quinn, 2006). In addition, some of the physiological properties and health effects of polysaccharides have been shown to include 'prebiotic' activity, essential for gastrointestinal health (Mann, et al., 2007; Marzorati, et al., 2010). For brain health, saccharides have been shown to influence cellular responses within the brain, including cell function and neurotransmitter activity, with some plant sourced polysaccharides demonstrating neuroprotective effects (Chan, Law, Lin, Lau, & Chan, 2007; Chang & So, 2008; Griessen, et al., 1989; Hirano, et al., 2003; Li, et al., 2011; Matthies, Staak, & Krug, 1996). In humans, one study showed improved health outcomes in terms of reduced severity of physical symptoms following 9 months of supplementation with plant sourced polysaccharides in patients with chronic fatigue syndrome (Dykman, Tone, Ford, & Dykman, 1998). Further studies are needed to investigate the impact of saccharides for physical health outcomes.

With regard to psychological well-being, to date two studies have shown that polysaccharide supplementation improves mood as assessed by the Profile of Mood States (POMS). Specifically, following 5 weeks of polysaccharide supplementation, there was a significant decrease in anger and significant increases in energy and positive outlook on life in a group of individuals diagnosed with alcoholism (Dykman & Briggs, 1997). More recently, utilising the same measure, there was a significant reduction in overall hostility and irritability and a significant increase in overall positive outlook on life following 12 weeks of polysaccharide supplementation in a group of healthy, middle-aged adults (Best, Kemps, & Bryan, 2010). Studies that examine mechanisms of effect suggest that saccharides may influence psychological well-being due to their involvement in the regulation of neurotransmitters (Backstrom, Westphal, Canton, & Sanders-Bush, 1995; Martinowich & Lu, 2008; Tate & Blakely, 1994), such as serotonin, that are involved in the modulation of mood states, such as anxiety and depression.

Research into polysaccharide effects in humans is a novel area of investigation and little is known about the participants' subjective experience of changes in well-being following polysaccharide supplementation. Understanding the effect of the supplementation from the participants' perspective provides a rich source of information to corroborate the impact of an intervention (Leidy & Vernon, 2008; Smith, 2005). Throughout the aforementioned 12 week polysaccharide supplementation study in middle-aged adults (Best, et al., 2010) participants were invited to provide anecdotal reports of their experience of well-being via semi-structured interviews. The present study sought to analyse these reports. Participants in the Best et al. (2010) study were randomly allocated to either a polysaccharide supplementation or a placebo condition, according to a double-blind, placebo controlled design. Information concerning perceived changes in well-being was collected at weeks 4, 8 and 12 of the study.

Examining perceived changes in well-being over these 4-week intervals enabled us to document any perceived supplementation effects over time. Because of the longer-term structural and functional role of polysaccharides in the human body and brain (Best, Kemps, & Bryan, 2007, 2009), we predicted an increase in perceived changes in well-being across the three scheduled interviews in terms of overall frequency and number of reported changes across time. We also analysed the content of the reports.

Method

Participants

There were 109 middle-aged Caucasian adults (aged 45-60 years) who took part in the study. Participants who had a history of serious mood disorders or psychiatric conditions, or had experienced recent major surgery or health conditions were excluded. Participants were recruited from the Adelaide metropolitan community local newspaper and television media advertisements and through word of mouth,. The sample included 38 males and 71 females. The mean age was 53 years (*SD* = 4.4). Participants had on average experienced 13.5 years of education (*SD* = 3.32), and rated their overall perceived health as good (*M* = 3.5, *SD* = 1.06), on a 5-point scale ranging from 1 (= poor) to 5 (= excellent). Further detail regarding the sample, recruitment methods and participant retention can be found in Best et al. (2010).

Procedure

Supplements

Participants took two teaspoons (3.6 gram dose) per day of either a polysaccharide supplement (Ambrotose®complex, a proprietary and patented blend of plant polysaccharides) or a placebo (rice flour starch powder) that were carefully matched for colour and texture. These materials were provided by Mannatech Inc (Coppell, Texas), and came in 75g containers. Participants took one teaspoon of supplement in the morning and one in the evening by either mixing the amount in a small glass of water or juice, or swallowing the amount straight from the standardised teaspoon. Participants recorded whether they had taken both teaspoons each day on a chart. The amount not consumed by the end of the study was determined by the number of teaspoon amounts left in the container out of the possible 168 serves (2 serves per day for 84 days). The experimenter and participants were blind to the supplement condition each participant had been randomly allocated to over the 12 week supplementation and interview period.

Interviews

During the 12 week supplementation period, participants were contacted by telephone 3 times at regular 4-week intervals: at week 4, week 8 and week 12 to provide feedback on their perceptions of well-being. Each time participants were asked three, pre-determined, semi structured questions: 1) how are you going with the supplements (a general question concerning participants' experience and progress in taking the supplement, 2) have there been any circumstances or events that have affected your present state of health and well-being, and 3) have you noticed any general changes in well-being over the last month? All three telephone calls were scheduled in advance in order to adequately capture the 4 week intervals for each participant.

At each time point, participants were informed that the interviewer was keeping brief notes on their progress and feedback. An open-ended, semi-structured interview style was used with summary statements utilised to reflect back to the participant the notes that had been taken. This was done to ensure that the interviewer had adequately captured the participant's feedback. The interviewer was a doctorate trained psychologist, well-trained to conduct open-ended interviews and take notes on the anecdotal feedback. Participants often openly conversed about a variety of issues relating to their experience of taking the supplement, including taste of the supplement, method of taking the supplement, if they had missed any days and general information about the study. The interviewer took notes from the verbal anecdotal reports.

Results

Compliance and consumption

Across the sample, compliance with the supplementation protocol was good with an average of 80 days out of 84 on which participants consumed the supplements. In addition, participants, on average, consumed 294g of the possible 300g of each supplement. Analyses of variance indicated that there were no significant differences between the polysaccharide and placebo groups in the number of days the supplement was consumed ($F(1,88) = 0.05$, $p = .98$): polysaccharide condition $M = 81.12$, $SD = 10.20$, placebo condition $M = 80.22$, $SD = 6.11$) or the percentage amount of supplement consumed across the 12 weeks ($F(1,88) = 0.32$, $p = 0.57$): polysaccharide condition $M = 98.32$, $SD = 4.28$, placebo condition $M = 97.66$, $SD = 5.15$).

Number of perceived changes

Of the total sample, 58 participants (38 females and 20 males) anecdotally reported perceived beneficial changes across the 12 week supplementation period, yielding a response rate of 53%. Of these, 42 were in the polysaccharide condition and 16 were in the placebo condition. Additionally, 43 participants reported no perceived changes (12 in the polysaccharide condition, 31 in the placebo condition), and 8 reported a negative change (5 in the polysaccharide condition, 3 in the placebo condition). The latter included 7 reports of increased flatulence and feeling bloated, and 1 report of feeling thirsty.

Chi-square analysis was used to determine the level of association between supplement conditions and the presence of anecdotal reports of perceived beneficial change and no change. Due to cell counts of less than 5, reports of perceived negative change were grouped with reports of no change. There was a significant association between conditions and whether or not there was a report of perceived beneficial change, X^2 (1) = 16.69, $p <$ 0.001. This represents, based on the odds ratio, that participants were 5.25 times more likely to report a perceived beneficial change if they were in the polysaccharide condition than if they were in the placebo condition. The results of the contingency table are presented in Table 1.

Content of perceived changes

The overall number of individual reports were grouped into different themes. Specifically, the interviewer established the description and content of each theme based on the terms used by participants. Across the supplement conditions individuals reported perceived beneficial changes in both physical and psychological well-being. As can be seen in Table 2, participants reported perceived beneficial changes primarily in energy, general sense of calmness, sleep quality, concentration and feeling clearheaded, as well as gastrointestinal health, reduced physical pain and improved skin condition. Example descriptions of each theme from participants in the polysaccharide condition are provided in

Table 3. To categorise the reports by themes, the first and second author explored and described the themes individually to determine a measure of inter-rater reliability ($r = 0.82$).

Perceived beneficial changes over time

To investigate changes in the number of perceived beneficial reports over time, a mean score was calculated for the number of reports in each condition for each time point; week 4, week 8 and week 12. Differences between supplement conditions for the mean number of reports at each time point were examined with a 2 (group: polysaccharide and placebo) x 3 (time points: weeks 4, 8, 12) Analysis of Variance. There was a significant Group x Time interaction ($F(2,112) = 3.45$, $p = 0.035$). Post hoc comparisons showed that participants in the polysaccharide condition reported significantly more perceived beneficial changes than those in the placebo condition at week 12, ($t(55) = 3.19$, $p = 0.002$). However, there were no significant differences between groups at week 4 (t (56) = 0.12, $p = .21$) or week 8 ($t(56) = 0.43$, $p = .67$). Figure 1 shows the mean number of beneficial reports across time for each condition. There were no significant main effects of Group ($F(1,56) = 1.29$, $p = 0.26$) or Time ($F(2,112) = 2.13$, $p = 0.12$).

Discussion

To our knowledge, this study was the first to explore perceived changes in well-being following a polysaccharide supplementation intervention. The results show that participants in the polysaccharide condition reported significantly more changes than those who received the placebo. This finding is consistent with previous research that has demonstrated improvements in well-being following supplementation with polysaccharides on a standardised measure of mood (Best, et al., 2010; Dykman & Briggs, 1997). Specifically, following 12 weeks of supplementation, middle aged adults in the polysaccharide condition of the Best et al. study were significantly less tense, hostile and had a more positive outlook on life than those in the placebo condition. These same participants perceived beneficial changes of supplementation themselves, as reported here. Thus, the current findings indicate that polysaccharides have an effect on perceived changes in well-being that are consistent with the reported changes captured by standardised measures of mood.

The content of the reports revealed that participants perceived beneficial changes in both physical and psychological well-being, particularly in energy levels, quality of sleep, gastrointestinal health, and sense of calmness, concentration and clear-headedness. These themes are consistent with previous research of polysaccharide effects. For example, the reports of perceived change in gastrointestinal health are consistent with mechanistic studies in animals that demonstrate positive effects of polysaccharide intake on gut function (Marzorati, et al., 2010; Matsumoto, et al., 2008). Similarly, the reports of perceived improvement in the experience of arthritic pain lend support to the findings of saccharide involvement in arthritic conditions (A. Alavi & Axford, 2008; Gelderman, et al., 1998; Kossi, Peltonen, Ekfors, Niinikoski, & Laato, 1999; Lefkowitz, et al., 1999). In addition, the perceived changes in psychological well-being are consistent with the role of polysaccharides within the brain that may influence the regulation of mood, namely cell interactions and neurotransmitter response (Chicoine & Bahr, 2007; Hirano, et al., 2003; Kleene & Schachner, 2004; Krishnan & Nestler, 2010; Martin, 2002; Matthies, et al., 1996).

The results of this study show that the number of perceived changes, when examined across time, was significantly higher for those in the polysaccharide condition in the last month of the study. This significant increase in the number of perceived reports from those in the polysaccharide condition towards the end of the study supports the hypothesised long-term effect of polysaccharides within the human body and brain. In particular, saccharides are thought to play a long-term structural and functional role in the brain, such as the development and function of neuronal membranes and synaptic junctions (Best, Kemps, & Bryan, 2005). As a result, any saccharide effects on mechanisms that influence well-being are likely to become apparent following intake over longer periods of time.

This study, as a preliminary exploration of perceived changes following polysaccharide supplementation, has expanded our current knowledge of potential saccharide effects on well-being. Overall, this investigation may lead to further research with stronger methodology and measurement to capture and categorise the well-being changes that polysaccharides may offer. Indeed, research into the effects of polysaccharides on well-being is in the early stages and emerging research suggests direct, functional physiological roles for these bioactive carbohydrates (A Alavi, Fraser, Tarelli, M, & Axford, 2011). Thus, future research should continue to investigate changes in well-being following polysaccharide supplementation with standardised measures and qualitative approaches that capture both physical and psychological effects.

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Table 1

Contingency table showing presence of anecdotal reports in each supplement condition

			Supplement condition		Total
			Polysaccharide	Placebo	
Presence of anecdotal report	Beneficial	count	42	16	58
		(% within cond.)	(71.2%)	(32.0%)	
	No-change	count	17	34	51
		(% within cond.)	(28.8%)	(68%)	
	Total Count		59	50	109

Table 2 *Frequency and percentage of perceived beneficial reports for each supplement condition*

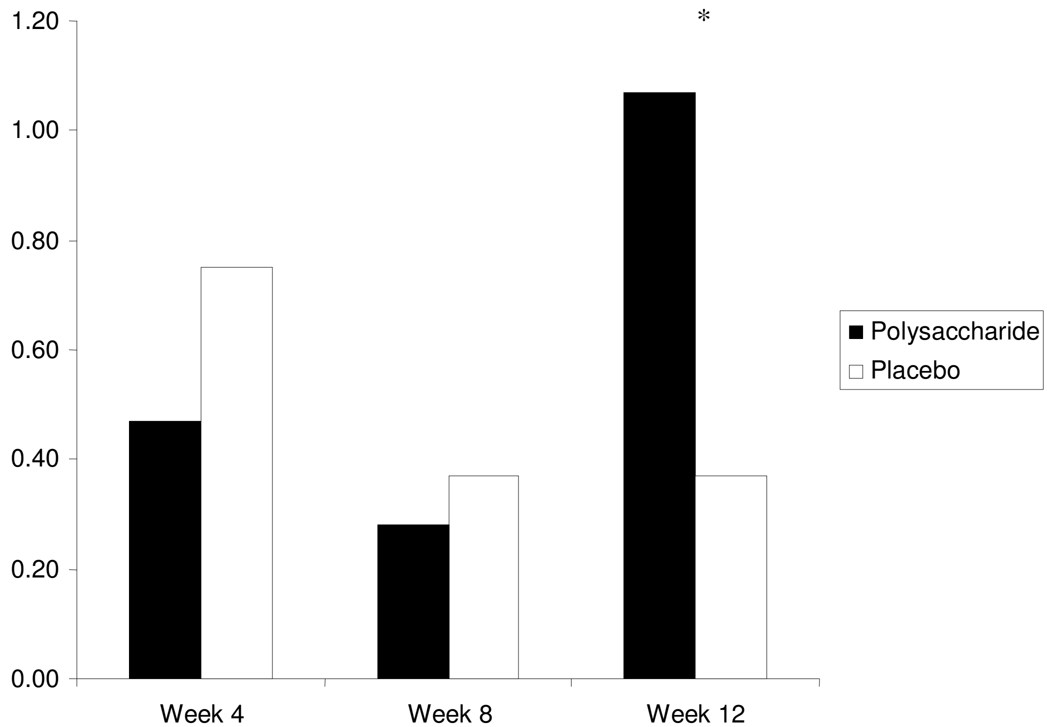
Theme	Supplement Condition		Total
	Polysaccharide	Placebo	
Increased energy	19 (32.8%)	8 (13.8%)	27 (46.6%)
Increased calmness	18 (31.0%)	5 (8.6%)	23 (39.7%)
Improved quality of sleep	15 (25.9%)	6 (10.3%)	21 (36.2%)
Increased clear-headedness	12 (20.7%)	3 (5.2%)	15 (25.9%)
Improved gastrointestinal health	7 (12.1%)	1 (1.7%)	8 (13.8%)
Reduced pain experience	3 (5.2%)	0	3 (5.2%)
Improved skin condition	1 (1.7%)	0	1 (1.7%)

Table 3

Description and examples of reports from participants in the polysaccharide condition

Theme	Examples
Energy	Participant described that they "had noticed more energy as I don't seem to struggle… doing things everyday seems to be easier like riding my bike and gardening…. I don't seem to be as tired and things don't seem to be as difficult."
Calmness	Participant described that "even though I feel stressed and tired… I feel not as scattered, but seem to feel more collected".
Quality of sleep	Participant described sleep as being " so much better, a really great change… a great bonus" because they were able to sleep well and get back to sleep if they awoke, which had previously not been the usual experience. Another participant described that their sleep had " dramatically improved, I feel really good and a lot more rested."
Clear-headedness	Participant described feeling "able to concentrate and more clear-headed…… seem to be losing train of thought less during the last few weeks". Another participant described that they felt they had improved from "75% to 85% in speed and accuracy, and general ability" when completing their crossword puzzle.
Gastrointestinal	Participant described that they seemed to experience more flatulence, appetite had increased and that their bowel movements had become "more regular" than usual. Another participant, described that their bowel movements "were so much better" and that whatever the supplement was "it has helped the frequency of everything a lot".
Pain experience	Participant described reduced pain, "I'm not as tired and the pain has improved in my wrists". Another participant described that their "arthritis is not as bad…. I don't seem to be in so much pain."
Skin condition	Participant described less irritations and "issues with skin" despite an increase in stress that would usually cause additional irritation, "…..my skin feels better… not sure why."

Figure 1: Mean scores for number of beneficial reports for each time point across supplement conditions



* p <.05