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Serbian Chemical Society

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I
KRATKI IZVODI RADOVA

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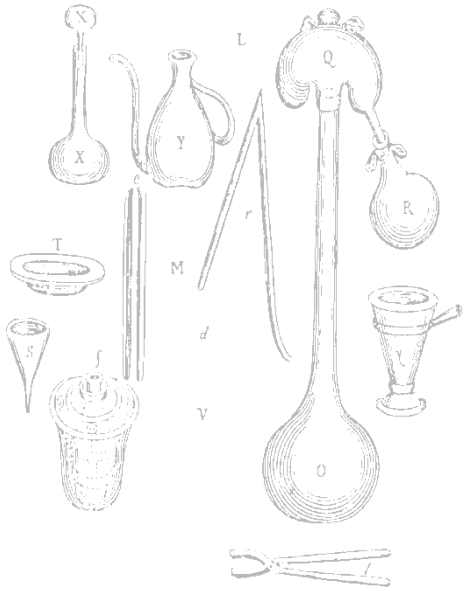

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BT09-P

β-D-glukan iz pekarskog kvasca: antioksidativne i bifidogene osobine

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Ćelijski zid pekarskog kvasca je glavni izvor nesvarljivog polisaharida β-D-glukana ((1→3),(1→6)-β-D-glukan). β-D-glukan je fiziološki aktivno jedinjenje (opšte poznato kao modulator biološkog odgovora), koji aktivira imuni odgovor domaćina protiv bakterijske, virusne, gljivične i parazitske infekcije, kao i neoplazija. Cilj našeg istraživanja je ispitivanje bifidogenog i antioksidativnog potencijala (1→3),(1→6)-β-D-glukana izolovanog iz pekarskog kvasca, kao novog prebiotskog dodatka infant formulama. Ukupan broj bifidobakterija nakon 48 h inkubacije u infant formuli sa dodatkom 0,1% (m /V) β-D-glukana (čistoće 99,54%) bio je značajno viši u odnosu na zrelo majčino mleko, infant formulu sa dodatkom inulina ili infant formulu bez prebiotika, kao referentne supstrate. Promene broja bifidobakterija praćene su promenama suve biomase, ukupnih bakterijski generisanih kiselina i pH. β-D-glukan najveće čistoće nema antioksidativnu aktivnost, dok prečišćeni ekstrakti glukana (93,15%, 75,54% i 49,30%) uklanjaju hidroksil radikale. Na osnovu bifidogenog efekta možemo da zaključimo da je β-D-glukan iz kvasca dobar kandidat kao novi prebiotik za dopunu infant formula.

Antioxidative and bifidogenic properties of baker's yeast β-D-glucan

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The cell wall of baker's yeast is a major source of nondigestible polysaccharide β-glucan ((1→3),(1→6)-β-D-glucan). Baker's yeast β-glucan is a physiologically active compound (generally named "biological response modifier") and is a broad-spectrum enhancer of host defense against bacterial, viral, fungal and parasitic infections, as well as neoplasia. The aim of our study was to investigate the bifidogenic and antioxidative potential of (1→3),(1→6)-β-D-glucan isolated from the baker's yeast (*Saccharomyces cerevisiae*) in relation to digestibility and purity, as a new infant formula prebiotic supplement. The total number of bifidobacteria after 48 h of incubation in the substrate composed of infant formula supplemented with 0.1 % (m/v) β-D-glucan (purity 99.54 %) was significantly higher than in mature breast milk, infant formula supplemented with inuline or infant formula without added prebiotic, which were used as reference substrates. Changes in the number of bifidobacteria were followed by the changes in dry biomass, total bacteria-generated organic acids and pH. In contrast, the purest β-D-glucan did not show any antioxidative activity, while partially purified glucan extracts (93.15%, 75.54% and 49.30%) scavenged hydroxyl radicals. Regarding to digestibility and bifidogenic efficacy *Saccharomyces cerevisiae* β-D-glucan could be a candidate as a new infant formula prebiotic supplement.

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INTRODUCTION

The cell wall of baker's yeast is a major source of nondigestible polysaccharide β-glucan ((1→3),(1→6)-β-D-glucan). Baker's yeast β-glucan is a physiologically active compound (generally named "biological response modifier") and is a broad-spectrum enhancer of host defence against bacterial, viral, fungal and parasitic infections, as well as neoplasia.

In some previous *in vitro*, animal and *in vivo* clinical studies, it has been reported that oat β-glucan has potential prebiotic efficacy. Prebiotics are "nondigestible (by the host) food ingredients that have beneficial effect through their selective metabolism in the intestinal tract." This effect is generally accepted to involve and increase in the populations and/or activity of *Bifidobacterium spp.*, and *Lactobacillus* species. β-Glucans and β-glucan oligosaccharides were previously shown to selectively stimulate the growth of lactobacilli populations in a rat model, which suggested that prebiotic activity could occur in humans.

The aim of our study was to investigate the bifidogenic and antioxidative potential of (1→3),(1→6)-β-D-glucan isolated from the baker's yeast (*Saccharomyces cerevisiae*) in relation to digestibility and purity, as a new infant formula prebiotic supplement.

MATERIAL AND METHODS

The fenton system and EPR measurements were previously described.[1]

The *in vitro* investigation, which lasts 48 h, was based on monitoring the effects of the substrate and potentially prebiotic substances (1,3-β-D-glucan) that have been previously treated with pancreatine, to the development of the mixed culture of bifidobacteria (*Bifidobacterium spp.*) isolated from the faeces of the three days old baby that is only breast-fed.
Seven substrates were used:

- Mature mothers milk (MM), as a reference substrate,
- Infant formula without glucan (IF),
- Infant formula supplemented with inulin (0.1% m/V) (IN), as a control substrate,
- Infant formula supplemented with glucans (0.1% m/V) of different purity:
  1. 49 %, 2. 76 %, 3. 93 % i **4. 99.5 %**

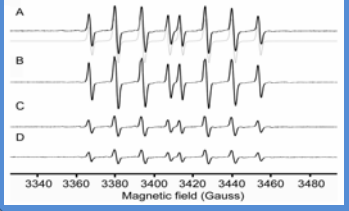
The indicators (in the beginning-index 0 and at the end-index 48) that we followed up are microbiological (the number of bifidobacteria and the dry biomass), and biochemical (pH, the total organic acids and the mole ration of acetic and lactic acid).[2] The reference substrate was the mature breast milk and infant formula with inulin was control substrate in the simultaneously performed tests.

The previous step in this research was the physiological and biochemical characterization against *in vitro* digestion by artificial saliva, gastric juice and pancreatine.[3]

RESULTS AND DISCUSSION

Gained results are shown in figures and in the tables.

FIGURE 1. A comparison of antiradical activity of glucans of different purities against hydroxyl radical (•OH) generated in the Fenton system (Fe^{2+} 0.2 mM; H_2O_2 1mM).



EPR spectra represent the signal of DEPMPO adduct with •OH (DEPMPO/OH), as verified by spectral simulation of DEPMPO/OH (gray). A) Fenton reaction; B) Fenton reaction + glucan (93.15 %); AA = 0.00 ± 0.02; C) Fenton reaction + glucan (75.54 %); AA = 0.70 ± 0.02; D) Fenton reaction + glucan (49.30 %); AA = 0.80 ± 0.04.

Our current study has shown that cell wall fraction with higher content of glucan does not possess any antiradical activity. Instead, the antioxidant activity of β-glucan extracts observed in other studies could be attributed to substances which are present in the extracts (cell wall constituents, such as pectin, mannan, and others), rather than to the capability of glucan itself to scavenge reactive oxygen species

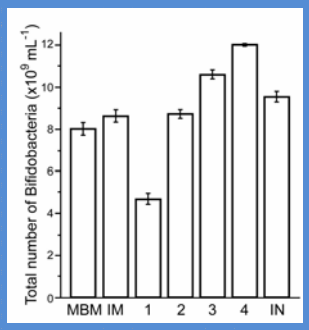
TABLE 1: BIOCHEMICAL INDICES OF BIFIDOGENESIS

Substrate	pH_0	pH_{48}	TOA^1_{48}	MR^2
1	5.5	4.1	0.128	3.02 : 1.90
2	5.5	4.1	0.146	2.89 : 1.79
3	5.5	4.0	0.160	3.10 : 1.98
4	5.5	3.9	0.192	3.16 : 1.93
IN	5.6	4.4	0.178	2.93 : 1.98
IF	5.6	4.4	0.105	2.94 : 1.92
MM	5.7	3.9	0.198	3.04 : 1.96

1**TOA**-Total organic acids, g/100mL.
2 **MR**- Mole ratio of acetic and lactic acid.

The mole ratio of the acetic and lactic acid is for all substrates approx. 3:2 which is the physiological-biochemical characteristic of Bifidobacterium genus (2). This means all the substrate changes occured under the effect of bifidobacteria.

FIGURE 2. The effects of substrates containing infant formula; infant formula and (1→3)-β-D-glucan extracts of different purities, mature breast milk, or infant formula with inulin on the number of bifidobacteria after 48 h of incubation.



Our findings demonstrate that β-D-glucan from baker's yeast stimulates proliferation of bifidobacteria. The effects on proliferation were positively related to the total glucan content of the cell wall extracts.

As expected, the most suitable substrate for the production of biomass was mature breast milk 0,325 g/100ml and among all other substrates, infant formula supplemented with the most pure β-glucan was the best 0,317 g/100ml.

CONCLUSION

In relation to its bifidogenic efficacy, our results show this baker's yeast β-D-glucan should be qualified as an indigestible nutraceutical suitable for use as a functional food ingredient and suitable as an infant formula prebiotic supplement. However, this *in vitro* study cannot reproduce the natural conditions in the gut of newborns. Therefore, further steps should include clinical study of infant formula containing this novel functional ingredient to determine its acceptability and biological value.

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