

FULL ABSTRACT

Potential of Black Soybean Tempe to Increase Level of In Vivo Secretary IgA and Proliferation of Lymphocyte.

The dissertation is written in Indonesian.

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Tempe is an Indonesian traditional food, especially for the Javanese, and is made from soybeans fermented by mould of *Rhizopus* spp. to produce a white cake-like product with typical flavour. Commonly yellow soybeans is used, however, in this research black soybeans was selected as the raw material.

Tempe was reported to have good nutrient contents, as well as many health benefits. Children with malnutrition and chronic diarrhea underwent quick recovery and nutritional improvement, as indicated by weight gain, upon tempe formula administration. It was assumed that this is due to modulation of immunity system both systemic and in gastrointestinal system. This research was aimed to observe the potential of black-soybeans tempe to increase activity of antioxidant enzymes, secretary IgA level, and proliferation of lymphocyte, in vivo.

Five steps of research activities were conducted, which were: 1) evaluation of nutrient composition and antioxidant compounds of several variety of soybeans, 2) the effect of species of tempe molds inocula (*Rhizopus stolonifer*, *R. oligosporus* and *R. oryzae*) and incubation times on mould growth, organoleptic properties, and activity of antioxidant in tempe, 3) the effect of tempe and the extract of black soybean tempe consumption on the activity of antioxidant enzymes, lymphocyte proliferation, and IgA secretary in *Salmonella typhimurium* infected rats, 4) the effect of tempe and extract of black soybean tempe consumption on the activity of human antioxidant enzymes and lymphocyte proliferation, in vivo, and 5) the effect of black soybeans extract on lymphocyte proliferation, activity of protein tyrosine kinase (PTK) and proliferating cell nuclear antigen (PCNA), in vitro.

Mallika black soybean variety contains anthocyanins, which is not found in the yellow soybeans samples (Grobogan and imported yellow soybean varieties). It also contains daidzein, oleic, and linoleic acid higher than those in other varieties. Mould growth on yellow and black soybean tempes, using the three fungus inocula (*Rhizopus stolonifer*, *Rhizopus oligosporus* and *Rhizopus oryzae*) proceeded during 36 hours fermentation process. The growth declined at 42 hours for *R. stolonifer* and *R. oligosporus*. However, *Rhizopus oryzae* that grew slowest, still grew at 42 hours incubation time. Generally, the pattern of mould growth, organoleptic properties, and activity of antioxidant were not different between yellow and black soybean tempe. Tempe quality, as judged using organoleptic method, for tempe produced using *R. stolonifer* inoculum, incubated for 36 hours were the best among all tempe. Although the antioxidant content still increased during prolonged incubation to 42 hours, the quality of the tempe was not accepted by the panelists. On rats fed black soybean tempe, tempe extract, combination of tempe and its extract, and standard diets the proliferation of T cell index were significantly different. The tempe diet had the highest stimulation effect. On human subjects,

tempe diet also showed the highest stimulation effect on T cell proliferation. However, there were no significant effect on the index of stimulation of B cell proliferation and the level of secretory IgA. Rats given tempe powder were able to increase the activity of antioxidant enzyme (SOD), lymphocytes proliferation (T cell), and lymphocytes survivor against hydrogen peroxide test. On human subjects, tempe consumption was able to increase lymphocytes proliferation (T cell) and lymphocytes survivor against hydrogen peroxide test. On in-vitro observation, ethanol extract of tempe was able to increase proliferation of lymphocytes, activity of PTK enzyme, and PCNA. These in vivo data supported T cell proliferation phenomena observed in in vivo rat and human study in addition to resistency to oxydation. It was concluded that consuming tempe increase cellular immune system.

Keys word: black soybean, tempe, lymphocyte proliferation and secretory IgA