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Isoflavones - from biotechnology to functional foods

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Abstract

Isoflavones are isolated from about 300 plant species and belong to the group of phytoestrogens. Having structural similarity with estrogens, they are related to the estrogen receptors, and may exhibit estrogenic and anti-estrogenic effects. They are present in many plant nutrients (including soy, alfalfa, flax seed). The main sources of isoflavones are legumes and there are known commercial preparations of isoflavones, which are natural, safe and alternative materials that can provide an effect similar to estrogen. These compounds have effects on the health status, production characteristics of the animals (poultry, pigs), and the characteristics of the final product ingredients.

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1. Introduction

During the past two decades, soy isoflavones (commonly genistein, daidzein and equol) have gained significant attention from the scientific community, primarily due to their beneficial effects in the treatment of ageing symptoms in both genders[1]. Namely, some positive outcome was noticed in the soy isoflavone treatment of breast, ovary and prostate cancer, and then osteoporosis, cardiovascular disease, diabetes, asthma, Kawasaki syndrome,

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menopausal symptoms, as well as psychological symptoms associated with aging[2,3,4,5]. Some isoflavones (genistein, daidzein), are considered to be natural selective estrogen receptor modulator for molecules binding to estrogen receptors and have selective activity towards different types of tissue for use in the prevention of treatment of certain diseases[6]. The amounts consumed isoflavones (ISF) foods differ. In Japan, where traditional food is consumed, the daily intake of isoflavones is 100 mg genistein and daidzein. In contrast, in America only about 1-3 mg of isoflavones is the average daily intake[7].

All of these effects depend on many factors, such as duration intake of isoflavones, their form (conjugated or not) and the degree of absorption, the dose, the individual characteristics - especially the concentration of endogenous estrogen. All this must be known when examining the effects of isoflavones on the health status of people, and therefore, their effects remain somewhat unclear. There are numerous positive effects in many hormone-dependent conditions, but there are many epidemiological studies that indicate harmful effects, especially in children and the development of some types of cancer.

2. Sources, use and effects of isoflavones

The best sources of natural isoflavones are legumes, particularly soy. In much smaller quantities, isoflavones can be found in foods of animal origin (meat, milk, eggs, fish)[8,9]. Isoflavones (daidzein, genistein and glycetein) are flavonoids made of two phenolic rings bonded to a carbon triple bond. Special attention was drawn when Kuiper *et al*.[10,11] found that genistein shows affinity for estrogen receptors, whereas the daidzein activity was significantly less (forty times). Isoflavones in nutrients may be present in four different chemical forms: non-conjugated, conjugated glucose (glycosidic form), acetyl glucoside and malonyl glucoside[12].

Recently, commercial preparations of isoflavones have become very popular; they are used as food for humans and animals (broilers, hens, pigs) in order to obtain safe natural alternative compounds that will take over the role of estrogen. Results of some studies suggest that isoflavones have great opportunities for used in food for people and animals, primarily preventive and therapeutic for many diseases.

Soy isoflavones are of interest and research prominence due to the abundance of these foods in the human diet, but on the other hand, testing the potential transmission of these compounds and their active metabolites from feed to the tissues and organs of animals is of great importance, ie. in foods of animal origin. This could enable increased intake of isoflavones, and result in production of functional foods, such is the case with many other supplements (e.g. Selenium, Conjugated Linoleic Acid) [13,14,15].

In experiments on broilers, addition of up to 80 mg of isoflavones per kg of feed over three weeks (from day 43 to 63), had a significant impact on the growth of body weight (10 or 20 mg of ISF/kg increased the growth by 13.6 and 16.2%, respectively, and increased the consumption of feed by 7.37% and 11.2%, respectively. Addition of 10 mg of ISF/kg improved the feed conversion by 5.5% during the fattening (42-63 days)[16,17].

The effects of isoflavones from feed to pig production performances show variability. Cook[18] reported that supplemental ISF (containing the isoflavones genistein, daidzein, and glycitein) increased ADG (average daily gain) in gilts from 6 to 30 kg of BW (body weight) and increased the percentage of mostly red muscle mass, but did not affect the white muscle and daily intake. However, in a second study, Cook[18] reported that dietary genistein did not affect ADG in castrated animals from 5 to 28 kg of BW. It was found that soy isoflavones led to an increase in length, weight and leanness body in male fattening pigs[19]. It appears that the reduced percentage of fat, and growing share of muscle tissue in the meat when isoflavones are added to feed, are more pronounced in males than females. The explanation lies in the hormonal activity of isoflavones, to which males are more responsive than females.

Soy isoflavones affect the meat quality of broilers. Supplementation with ISF 40 mg/kg in the diet increased the water binding capacity to 17.24%, and amounts of 20 or 40 mg/kg significantly increased the pH of the meat. Adding 40 or 80 mg of ISF/kg increased a* value (redness) and reduced L* value (lightness) of meat[16].

Isoflavones in the feed of laying hens significantly affected egg production, egg weight and feed conversion. Shi *et al*.[20] have shown that isoflavones added as supplements in the diet of laying hens during the later period of laying, after the peak production, significantly affect egg production, egg weight and feed conversion. It has been shown that these compounds are involved in calcium metabolism, thus leading to a decrease in intracellular calcium concentration in osteoclasts, which leads to an increase in the amount of calcium for shell formation. Therefore, the strength of the shell, shell thickness, shell percentage ratio of the mass and the mass of the egg exhibit linear-