World Nutrition Journal |eISSN 2580-7013

SUPPLEMENTARY ARTICLE

Benefit and Challenge of Soy Plant-based Formula in Infants and Children

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Received 10 April 2020,
Accepted 24 April 2020

Link to DOI:
10.25220/WNJ.V04.S1.0001

Journal Website:
www.worldnutrijournal.org

Introduction

The first report of soy being administered to an infant is over 100 years old.[1] Since the 1960s the composition of soy formula has been better adapted to the nutritional needs of infants and since 2000 infant formula based on soy fulfils European Directives and legislation for infant feeding.

Soy infant formula contains a soy protein isolate (95% protein), and methionine, carnitine, taurine, iron, calcium phosphor and zinc are added. Heating destroys the anti-protease activity of soy for over 90 %. In 2016, soy infant formula was still 12% of the USA market and 25 % of infants were fed soy infant formula during their first years of life.[2]

In 2006, ESPGHAN published a consensus statement regarding soy infant formula: i) soy protein formula can be used for feeding term infants, but they have no nutritional advantage over cows' milk protein formula and contain high concentrations of phytate, aluminium, and phyto-estrogens (isoflavones), which might have untoward effects; ii) there are no data to support the use of soy protein formulae in preterm infants; iii) indications for soy protein formula include severe persistent lactose intolerance, galactosemia, and ethical considerations (e.g., vegan concepts); iv) soy protein formula have no role in the prevention of allergic diseases and should not be used in infants with food allergy during the first 6 months of life; v) if soy protein formula are considered for therapeutic use in food allergy after the age of 6 months because of their lower cost and better acceptance, tolerance to soy protein should first be established by clinical challenge.[3] The cut-off age of 6 months was debated and tended to be followed, although based on weak scientific evidence.

According to a review by Katz et al,[7] based on the information obtained out of 40 studies identified, the established weighted prevalence of soy allergies is 0 to 0.5 % (0.27) for the general population, 0.4 to 3.1 % (1.9) for the referred population, and 0 to 12.9 % (2.7) for allergic children. The prevalence of sensitization after the use of soy infant formula is 8.7 and 8.8 %, depending on the method used.[7] According to this review, there is no difference according to the age of

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6 months. A recently published Mexican consensus paper confirmed the statements of the AAP and concluded that there was no safety issue with soy infant formula.[8] Soy infant formulas have important advantages in terms of cost-benefit, palatability and effects on the intestinal microbiota, compared to other formulas.[8] Although evidence to recommend its use in functional digestive disorders is limited, soy infant formulas have an adequate safety profile and are a valid option for infant feeding.[8]

Infants fed soy infant formula have a normal growth.[9] Lactose-free formula has been recommended in the re-alimentation of an infectious gastroenteritis after failure of lactose-containing re-alimentation.[5] Lactose-free re-alimentation results in a decreased need for hospitalization according to data from Thailand.[10]

Anthropometric patterns of children fed soy infant formula are similar to those of children fed cow's milk formula or human milk.[11] Despite the high levels of phytates and aluminium in soy formula, haemoglobin, serum protein, zinc and calcium concentrations and bone mineral content were found to be similar to those of children fed cow's milk formula or human milk.[11]

Soy formulae used to contain phytates which were blamed for their chelating capacity, preventing the proper absorption of micronutrients.[12] Today, however, phytates are almost totally removed from the soy formulae.[12]

The levels of genistein and daidzein to be higher in children fed soy infant formula; however, no strong evidence for a negative effect on reproductive and endocrine functions was found.[11] Immune measurements and neurocognitive parameters were similar in all the feeding groups.[11] Phyto-estrogens are plant compounds with estrogenic activity. Those contained in soy formula (SF) are of the isoflavone class and include, in order of quantitative and biological importance, genistein, daidzein, and glycitein.[13] All have a molecular structure quite similar to that of the human female hormone 17-β-oestradiol and, consequently, have estrogenic activity, even if 1,000–10,000 times lower.[13] They are present in very large amounts in soy formula, although with differences among commercial preparations. It has been calculated that the mean daily intake of isoflavones by an infant exclusively fed with one of the presently marketed soy formula can be as high as 11 mg/kg body weight, an amount significantly higher than that necessary to exert hormone-like effects in adults.[13,14] According to other data from literature, the isoflavone intake of an infant fed breastmilk or cow milk formula is 0.005–0.01 mg/d, while with soy infant formula amounts of 6–47 mg/day are reached.[15] This intake is similar to the daily intake by an adult with a standard Asian diet (8–50 mg/d) or vegan diet (15–60 mg/day), while vegetarians have a lower intake (3–12 mg/day).[15] A standard Western diet has an isoflavone content of 0.5 – 3.5 mg/day.[15]

A global evaluation of the impact of modern soy formula on human development seems to suggest that their use is not associated with relevant abnormalities.[13] The negative influence of isoflavones, which has been repeatedly demonstrated in developing animals, has not been evidenced with the same relevance in humans. Only children with congenital hypothyroidism can have problems and require re-modulation of thyroid hormone replacement doses. The potential harmful effects of soy isoflavones on child development cannot be definitively excluded.[13] The consumption of soy-based infant formula is not associated with early onset of puberty.[16] Relative to girls fed with cow-milk formula, those fed with soy formula demonstrated tissue and organ-level developmental trajectories consistent with response to exogenous estrogen exposure.[17] However, these effects seem to be transitory as no early infant feeding effects were found on reproductive organs volumes and structural characteristics in children age 5 years.[18]

The other concern to take into consideration is the use of transgenic soy in formulas.[12] The US Department of Agriculture records that up to 93% of soybean crops are transgenic.[12] Adverse effects of transgenic soy were never reported.

The addition of fiber offers an additional benefit in infants and young children with constipation. About 10 % of all infants and young children are constipated.[19] Although all functional gastro-intestinal disorders are considered as separate entities, over 75 % of the infants present with a combination of functional disorders.[20] Fibers lead to an increase of bowel movements and improve stool consistency.[21] Fiber has a significantly improved success rate compared to placebo.[21] Prebiotic oligosaccharides were shown to increase the defecation frequency and to soften the stools.[22,23] The addition of oligo fructose regulates defecation irregularities associated with low fiber intake.[24] A consistent prebiotic effect along with a decrease in pH and increase in %-bifidobacteria and %-lactobacilli was found in a group administered 0.4 g inulin/100 mL.[25]

Conclusion

Soy infant formula is a valuable alternative for cow milk based infant formula, since nutritional safety and no long-term adverse effects were reported. The supplementation with fiber is effective in the management of constipation.

Conflict of Interest

Authors declared no conflict of interest regarding this article.

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