



PEDIATRIC NUTRITION

April 2011

**A Practical Evaluation of the Benefits and Risks of
Soy-based Formulas**

Soy-based formulas have a long history of successful use in the management of cow's milk allergies with similar cost to milk-based counterparts. Nevertheless, they are not recommended by expert organizations out of concern that between 10 and 14% of infants with IgE-mediated cow's milk allergy will also be allergic to soy. Some pediatricians feel that this is unnecessarily restrictive, as soy formulas are often better tolerated than more expensive alternatives. Soy-based formulas have also been shown to be beneficial in the management of diarrhea, shortening the duration of illness. Also, other non-soy-based formulas which do not contain palm olein have gastrointestinal effects that more closely resemble those of human milk, allaying parental fears that transitioning from breast milk to formula may be constipating.

Soy-based formulas have a long history of successful use in the management of cow's milk allergies. That said, several organizations, including the Canadian Paediatric Society, recommend that parents use extensively hydrolyzed formulas for infants who are allergic to cow's milk protein; if a non-IgE-mediated allergy to cow's milk protein is ruled out, then soy formulas may be used. As of 2008, the American Academy of Pediatrics also recommends extensively hydrolyzed protein formulas for infants with documented cow's milk protein allergy as 10% to 14% of these infants will also be allergic to soy.

Why such caution? Differentiating between IgE-mediated allergic reactions and non-IgE-mediated reactions can be difficult. Perhaps it is simpler to issue blanket statements covering both types of allergic reactions rather than have separate recommendations for each type. However, like other experts, Dr. Stacie Jones, Professor of Pediatrics, University of Arkansas for Medical Sciences, Little Rock, feels that the percentage of children who are classically (IgE-mediated) allergic to both soy and cow's milk protein is extremely small. As she mentioned, the prevalence of cow's milk allergy in Western countries is only about 2% to 3%; of these, she estimated that <10% of infants with IgE-mediated cow's milk allergy are also allergic to soy.

This is in contrast to infants with non-IgE-mediated cow's milk allergy, about half of whom will also be allergic to soy and for whom soy-based protein formulas are not recommended by any expert group. In a study by Zeiger et al. (*J Pediatr* 1999;134:614-22), 93 children under the age of 3.5 years with documented IgE-mediated cow's milk allergy were subjected

to a double-blind, placebo-controlled food challenge or an open challenge to test for soy allergies. Children tolerant of soy at study entry received soy formula and were followed for 1 year. At study entry, 12 children definitely were allergic to soy and 1 additional child was thought to develop soy allergy after 1 year of receiving soy formula.

The authors therefore concluded that soy allergy occurs only in a small minority of young children with IgE-mediated cow's milk allergy and as such, may provide a safe and growth-promoting alternative for the majority of children who prove allergic to milk. Businco et al. (*Am J Clin Nutr* 1998;68(suppl):1447S-1452S) also pointed out that few researchers have used a challenge test for the diagnosis of soy allergy; in most studies, the diagnosis was based on anecdotal case histories reported by parents that were not substantiated by scientific diagnostic criteria. Consequently, the true prevalence of soy allergy may be open to debate.

Soy-based Formula Benefits

There is no good evidence supporting the notion that soy-based formulas should not be used for infants under the age of 6 months, as Dr. Jones pointed out, or that feeding infants soy-based formulas compromises growth or development.

In fact, it may also help resolve colic. In a study involving 70 infants with severe colic, symptoms remitted in 50 out of 70 infants when their cow's milk protein formula was replaced with a soy protein-based diet; when rechallenged, symptoms flared in all 50 infants (*J Pediatr Gastroenterol Nutr* 1991;12:332-5).

Soy-based formula has also proven useful for the management of severe diarrhea. Dr. Mathuram Santosham, Professor of International Health and Pediatrics, Johns Hopkins University, Baltimore, Maryland, for example, was the first to demonstrate this in infants who received WHO oral rehydration solution (ORS) for 4 hours, followed by the combination of the WHO ORS plus full-strength Isomil, a soy-based formulation, until the diarrhea resolved. They had significantly less stool output throughout the duration of the illness and about a 40% shorter duration of the illness than controls who were left on the initial WHO ORS solution for 48 hours, followed by ORS plus half-strength Isomil for another 24 hours, and the combination of ORS plus full-strength Isomil some 72 hours later.

Exploring Different Formulas

According to pediatricians, mothers frequently switch to a different formula when they think the formula they are using is causing constipation, fussiness or excessive spit-up or vomit. Some mothers are also concerned that iron-fortified formulas are constipating and that transitioning infants from breast milk to iron-fortified formulas may be difficult. However, several researchers have argued that this is not necessarily the case, depending on the formula used. In 1 study (*Pediatrics* 1999;103(1):1-6), Lloyd et al. compared the tolerability of 2 powder iron-containing infant formulas: Similac without palm olein and Enfamil with palm olein. While the incidence of spit-up and vomiting did not differ between the feeding groups, infants weaned to the palm olein-containing formula had less frequent and harder stools than infants weaned to the Similac formula without palm olein.

As the authors explained, the inclusion of palm olein in an infant formula may explain the difference in stool characteristics because palmitic acid from palm olein tends to form insoluble soaps, which leads to harder stools. Transitioning infants to a formula that does not contain palm olein therefore may ease the transition from breast milk to formula feeding and allay parental concerns that their infant will become constipated if fed an iron-fortified formula.

Gastrointestinal (GI) tolerance to different infant formulas was also evaluated in a much larger study (*Nutrition*

2002;18:484-9) involving close to 7000 infants. Infants received human milk; Similac Advance; other infant formula; human milk plus Similac Advance; or human milk plus other infant formula. At the end of 2 weeks, infants fed human milk had softer and more frequent stools than infants who received any other combination of milk and formula. Importantly, infants fed Similac Advance had softer and more frequent stools than those who were fed other formula. Regurgitation as well as colic were also significantly more likely to occur in infants fed other formula than those fed Similac Advance.

Potential Cascade Effect of Palm Olein

These and related findings indicate that formulas can affect infant GI tolerance differently and mothers need to be reassured that some infant formulas are more likely than others to have GI effects similar to those of breast milk. The addition of palm olein to some infant formulas may also have unintended physiological consequences on calcium and fat absorption. It has been reported by a number of authors that palm olein added to formulas leads to diminished intestinal absorption of fat, palmitic acid and calcium.

Diminished calcium absorption can also lead to lower bone mass. This was demonstrated by Koo et al. (*Pediatrics* 2003; 111:1017-23), who found that by 3 months of age, infants fed Similac with iron (which does not contain palm olein) had significantly greater bone mineral density measures than infants fed Enfamil with iron (which does contain palm olein).

Summary

Cow's milk allergy in infants is uncommon but when it occurs, parents obviously need to find an alternative. For some pediatricians, soy-based formulas still represent a viable choice as only a small percentage of infants are allergic to both cow's milk and soy, and soy is well tolerated. Formulas that do not contain palm olein more closely resemble the GI effects of human milk and should help ease the transition from breast milk to formula. □

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