Paradigm Shift in the Management of Milk and Egg Allergy: Baked Milk and Egg Diet

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KEYWORDS

• Food allergy • Egg allergy • Milk allergy • Baked milk diet
• Baked egg diet • Thermal processing • Heat treatment
• Allergenicity

Cooking can make food more palatable, change flavor, texture, or even color, and improve digestibility. In addition to flavor and texture enhancement, thermal processing, such as pasteurization or sterilization, is used to eliminate microorganisms and thus ensure microbiological safety. These alterations in sensory, nutritional, and physical properties are the result of protein denaturation during thermal processing. The effect of heat on allergenicity is variable and food dependent. For peanut (dry roasting)[1] and shrimp (boiling),[2] high temperatures seem to increase allergenicity. However, for cow's milk and hen's egg, allergenicity is attenuated. These recent findings, in both the laboratory setting (mouse) and clinical setting (man), have set the stage for a paradigm shift in food allergy management. Strict avoidance has been the standard of care for food allergy for decades, but more recent studies have supported the safety and potential benefits of inclusion of extensively heated products containing milk and/or egg into the diet of those who are nonreactive.

EFFECT OF THERMAL PROCESSING ON ANTIGENICITY AND ALLERGENICITY

Epitopes are defined as the portions of the antigenic molecules, typically proteins, that can bind with the complementary site of an antibody. There are 2 types of epitopes: (1) sequential or continuous or linear (based on the primary structure of the molecule), in which the antibody binds to a contiguous stretch of amino acid residues within the

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peptide, and (2) conformational or discontinuous (based on the secondary or tertiary structure of the molecule), in which the antibody binds to noncontiguous amino acid segments that are distantly separated within the protein and are brought into proximity by the folding of the molecule (**Fig. 1**).[3] The structure of an epitope and the physicochemical properties of the component amino acids define the antigenic specificity of this epitope. Any change in the structure, including a single amino acid substitution or destruction, may influence antigenicity.

When food allergens are exposed to heat, allergenic activity may be unchanged, decreased (perhaps abolished), or even increased.[4] These phenomena can be explained by inactivation, denaturation, or destruction of epitope structure; formation of new epitopes (neotopes); or exposure of hidden epitopes after unfolding (cryptotopes).[5,6]

The clinical (symptomatic) expression of food allergy, specifically to milk and egg, has been attributed to individual epitopes in case-control, cross-sectional,[7–12] and longitudinal cohort studies.[13] Transient and persistent allergy have been attributed to recognition of primarily conformational and sequential epitopes, respectively. Greater IgE epitope diversity recognition and higher binding affinity are also associated with increased severity and persistence of disease.[13]

Thus, the aforementioned heat-induced changes on the physical and biological properties of cow's milk and hen's egg are expected to affect predominantly conformational epitopes, existing only when the tertiary and secondary molecular structure remains intact, whereas more limited effects are expected on sequential epitopes.

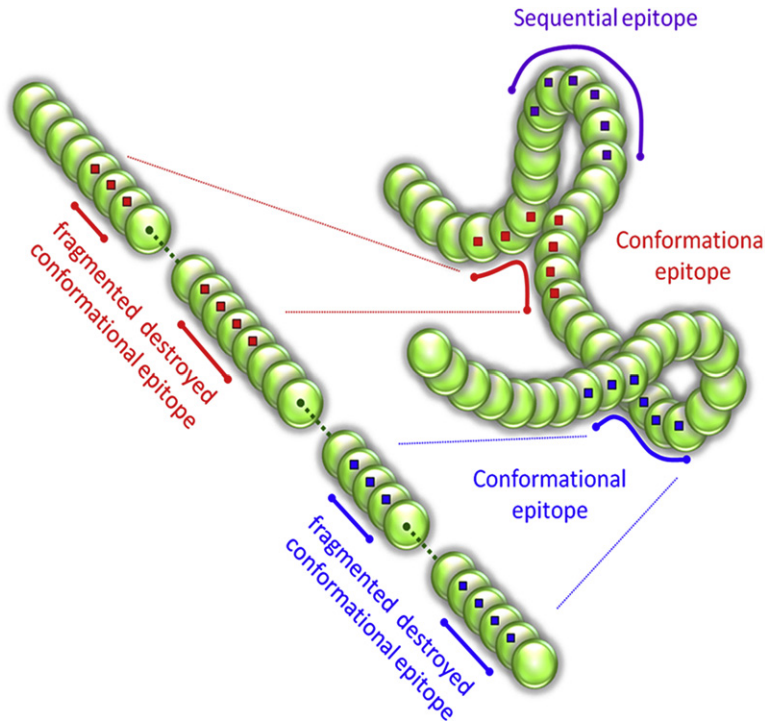

Fig. 1. Effect of thermal processing on the structure of proteins and epitopes.