

Introduction & Methodology

The aim of this project was to investigate whether the structure and texture of a cake could be maintained once the butter or egg was removed by the addition of interfacially active particles. For these investigations two types of cocoa particles were tested, a high fat and low fat cocoa particle. As we have previously reported the use of these particles to stabilise oil-in-water and water-in-oil emulsions¹, we hypothesised these same particles may have the same functionality at the air/hydrophilic matrix interface. The cakes were produced following the traditional all-in-one preparation method and baked in a conventional oven. The standard formulation included four equal quantities of butter, sugar, fat and egg. For the experimental formulations the butter or egg ingredient was replaced with cocoa particles and water.

Reduced – Fat Cake

As obesity rates worldwide continue to increase there is a growing interest in designing food structures with lower fat whilst maintaining the texture and taste expected by consumers. In order to reduce the fat in a cake formulation we substituted the butter with the two types of cocoa particles.

Standard Formulation



Standard Formulation
Butter Removed



Butter Removed
Cocoa particles added



Low Fat Cocoa Particle



High Fat Cocoa Particle

Removing the butter from the formulation produced a cake of similar appearance to the standard formulation but with a dry and rigid texture. The addition of low fat cocoa particles maintained an aerated structure and a springy texture. High fat cocoa particles, which are not able to stabilise an aqueous foam, produced a cake with a dense and gelatinous texture.

Egg-Free Cake

Egg allergy is one of the most frequent food allergies in childhood, found in approximately 2% of children². Many children will outgrow their allergy, however it is still reported that 0.5% of the UK population are allergic to egg³, motivating the requirement for eggs to be one of the fourteen allergens declared on food labels⁴. It is for these reasons that we were prompted to investigate whether cocoa particles can be used to replace egg in a cake formulation.

Standard Formulation



Standard Formulation
Egg Removed



Egg Removed
Cocoa particles added



Low Fat Cocoa Particle



High Fat Cocoa Particle

As it can be seen from the images, the presence of low fat cocoa particles produced a cake structure comparable to the standard formulation, whereas the addition of high fat cocoa particles created a cake with a very dense texture

Conclusions and Future Outlook

In these preliminary investigations we have tested the ability to use two types of cocoa particles to replace the butter or egg ingredients in a cake formulation. We found the presence of fat in the cocoa particle prevented the formation of an aerated structure in both cases, this result was to be expected as the presence of fat at an air/water interface is known to have a destabilising effect. In comparison, the presence of a low fat cocoa particle enabled the reduction of fat and removal of egg whilst maintaining an aerated structure. The egg-free cake with the addition of low fat cocoa particles had a texture, springiness and eating quality very comparable to the standard formulation. These investigations have validated the potential use of cocoa particles to structure and reformulate cakes and potentially other aerated food products. Ongoing work includes instrumental texture, bulk density and structure analysis based on experimental formulation design.

¹ Gould, J., Vieira, J., & Wolf, B. (2013). *Food & function*, 4(9), 1369-1375.

² www.food-info.net

³ www.egginfo.co.uk

⁴ www.food.gov.uk