STUDY ON THE POTENTIAL OF CHIA GEL USAGE AS A NATURAL FAT SUBSTITUTE IN CAKE FORMULATION

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BACKGROUND

In the current study, cakes were prepared with the addition of different levels of chia gel obtained by soaking 1 part of chia seeds in 9 parts of water by weight. Mix was allowed to stand for 30 min for gel formation and seeds were left in the gel and later incorporated into the batter. The addition of chia gel to cake batter to partially substitute the fat from the basic recipe (control) resulted both in improved quality characteristics at all levels of substitution and reduction of caloric value, at the expense of energy from fat, especially at higher reduction levels (40 and 60%). The fat replacement at 40 and 60% had a caloric value decrease by 48 kcal per 100 g compared to the control and respectively the energy at the expense of the fat was 37.9 and 25.7% (reduction by 71.3% and 48.3%). Sensory evaluation demonstrated good acceptability for all the products with slight prevail for the samples with 40% followed closer by those with 20% fat replacement. Hence, chia gel proved to be a good alternative for fat substitution in baking goods recipes while preserving the quality and sensory parameters aiming to produce healthier foods.

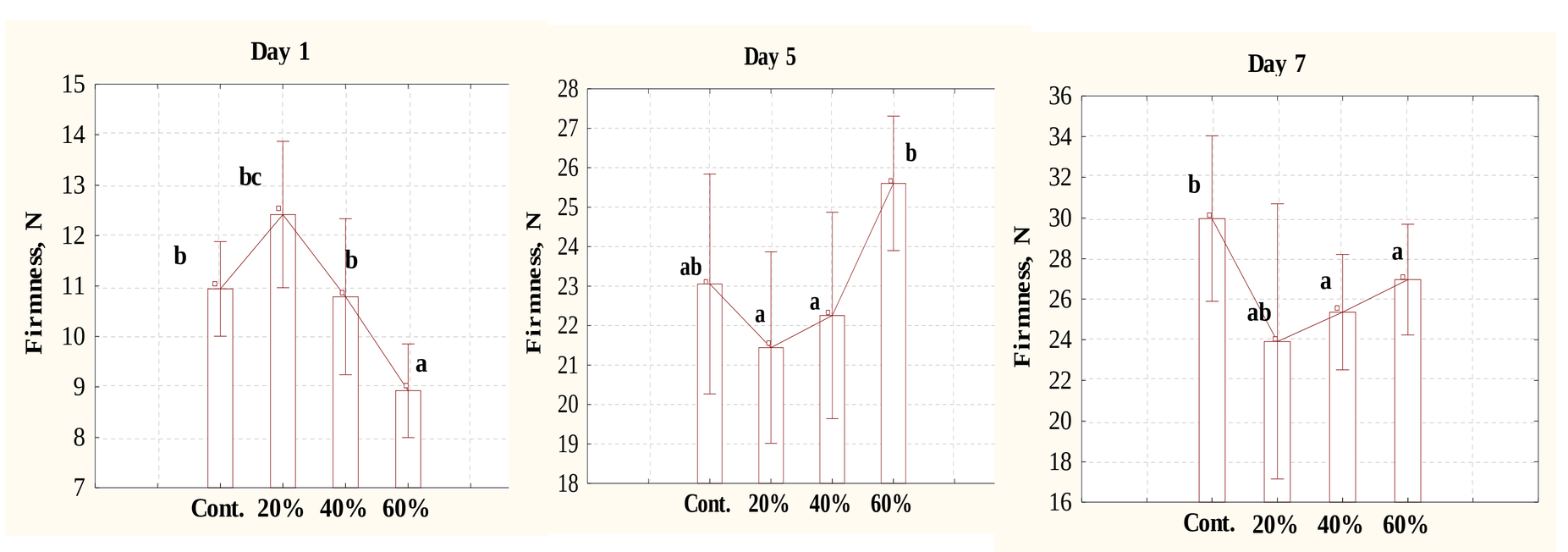
MATERIALS AND METHODS

All variants of the cake batters preparation together with the nutritional contents are shown on Table 1. The oil fat according to the basic recipe was replaced with a gel of chia at levels of 20, 40 and 60%, and the sample without the addition of gel represented the control. Prior to the batter preparation, chia seeds were soaked in tap water in a ratio of 1: 9 for about 30 minutes to form a gel as described by BORNEO at al. (2010) and the exact amount to add in each formulation was calculated. The batter samples of 450 g were baked at 180˚C for 40 min in a commercial oven. After baking the cakes cooled down for 2 h, placed in plastic bags and stored at room temperature at different storage times (0, 24, 48, 72, 96, 120 and 150 h). Differential Scanning Calorimetry (DSC) Analysis (DSC 204 F1 Phoenix NETZSCH-Gerätebau GmbH, Germany) was used to study either the process of starch gelatinization and determination of the state of water in the cake batter system - bound or free (HATAKEYAMA et al, 1988) and to determine the peak of fat melting. Texture profile parameter of "firmness" was measured by using texture analyzer (StableMicroSystems TA-XT2Plus). Crumb firmness (N) of cake samples was found during storage at times given. The biochemical composition of fresh cakes was determined: moisture, protein, lipid and fiber content were measured according to Bulgarian State Standards (BDS 12145, BDS 14431, BDS 6997 and BDS 11374, respectively). The energy value of the cakes was calculated empirically. Consumer acceptance test was performed using 9-point hedonic scale. The analysis of the results was performed with the statistical program Statistica 7.

Table 1. Nutrition content of cakes prepared using 20%, 40%, and 60% oil replacement with chia gel

Samples	Ingredients, g/100g: White flour	Sucrose	Cow's milk	Eggs	Sun flower oil	Chia gel	Baking powder	Aroma	Nutrient content per 100g serving: Energy (kcal)	Energy from fat, %	Lipids, % d.w.	Carbs, % d.w.	Proteins, % d.w.	Fibers, % d.w.	Moisture, % d.w.
20%	25.5	33.0	18.0	15.0	6.0	1.5	1.0	0.1	213.0	40.2	8.8	32.5	4.0	10.8	21.9
40%	25.5	33.0	18.0	15.0	4.5	3.0	1.0	0.1	179.0	37.9	7.5	32.7	4.5	12.2	25.5
60%	25.5	33.0	18.0	15.0	3.0	4.5	1.0	0.1	179.0	25.7	5.1	32.5	4.8	14.4	25.6
Control	25.5	33.0	18.0	15.0	7.5	-	1.0	0.1	227.0	41.9	10.6	32.3	4.4	8.4	20.6

Effect of chia gel added in different levels of fat substitution on the crumb firmness of cake samples during storage (* means with different letters are significantly different, p≤ 0.05)



40% chia gel cake batter starch gelatinization by DSC

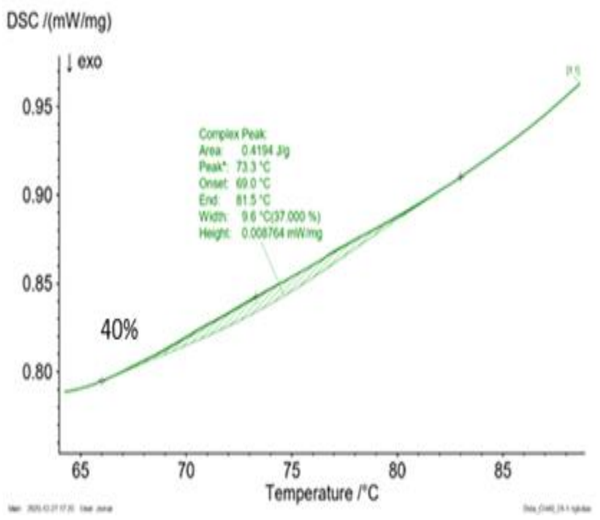


Table 2. Chia gel fat substituted cake batters starch gelatinization and the control

Batters	Temp. interval, ΔT, °C	Endothermic pick temp., T_p, °C	Enthalpy, (ΔH), J/g
20% fat reduction	68.4 – 80.0	68.9	0.3799
40% fat reduction	69.0 – 81.5	73.3	0.4194
60% fat reduction	78.4 – 83.9	83.4	0.517
Control	65.6 – 79.7	77.3	0.3138

RESULTS

Obviously, the chia gel because of high water retention capacity affected its loss during storage and thus slowed down the staling. Evaporation of water from the surface of the end product, during and after baking does not occur to such an extent, because the gel rich in fibers, binds free water. This is also explained by the fact that thanks to the added chia, the hydration in the conditions of the batter increases. This is most likely due to the ability of the gel to absorb the free water and then more energy to release it is needed during the starch gelatinization in the batters. In the products with 20 and 40% substituted fat, probably again due to the lower content of free water, gelatinization during baking was incomplete what explains the fact the samples tested were less firm and with moist mouthfeel if compare to the control for the entire storage period of 7 days. It has been found that the addition of chia gel, in order to replace the fat in a cake recipe, significantly improves the firmness of the crumb, slows down staling process and reduces the caloric value, at the expense of the energy from fat in the cake product and can therefore be recommended for incorporation.