



Formulation of Non-Fat Yoghurt Drink with Butternut Squash (*Cucurbita moschata*) Puree: Optimization Using Response Surface Methodology

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Rising demand for healthier foods has driven interest in low-fat, low-sugar yoghurts, though such reductions often impair quality. Butternut squash (*Cucurbita moschata*), a pumpkin variety shows a strong potential as a natural fat and a sugar replacer due to its rich content of dietary fibre, pectin, starch, and sugars. The current study aimed to optimize the formulation of non-fat drinking yoghurt by incorporating *C. moschata* puree using Response Surface Methodology (RSM). Thirteen yoghurt formulations were prepared, varying the levels of pumpkin puree (4–12%) and sugar (2–6%), according to the Central Composite Design of RSM. The process involved pumpkin puree preparation, yoghurt preparation and blending to produce drinking yoghurt. The yoghurts were analyzed for compositional, physicochemical and physical properties using standard methods. Sensory evaluation was conducted by a panel of 30 semi-trained assessors. Response variables used in the optimization study were the viscosity and the overall acceptability. Data were analyzed using RSM in Minitab (version 17) and ANOVA followed by Tukey's test in SPSS (version 25). Total solids, protein and ash percentages of the yoghurts were varied from 10.26 ± 0.24 to 17.65 ± 0.02 , 3.44 ± 0.01 to 3.62 ± 0.12 and 0.20 ± 0.01 to 0.54 ± 0.14 , respectively. pH varied from 3.85 ± 0.05 to 4.75 ± 0.05 and titratable acidity from 0.72 ± 0.01 to 1.40 ± 0.01 (% lactic acid) and showed a significant variation without any clear trend. A notable increase ($p < 0.05$) in the b^* (yellowness) value and the viscosity was observed with the increase of *C. moschata* puree level in the yoghurt. A non significant ($p > 0.05$) lack of fit observed for viscosity (0.729) and overall acceptability (0.463) indicates that the quadratic model with the independent variables significantly ($p < 0.05$) predict the dependent variables. The optimized formulation, containing 5.51% *C. moschata* puree and 6.60% sugar, achieved an ideal balance of creaminess and natural sweetness and resulted in 3.97 overall acceptability score and 852.94 cP viscosity as predicted by the model which were closely aligned with the desired response values. The findings indicate that *C. moschata* puree can serve as an effective functional ingredient to enhance the quality of non-fat drinking yoghurt.

Keywords: Optimization, Response surface methodology, Sensory, Viscosity, Yoghurt