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Effect of partial substitution of wheat flour with lupine (Lupinus mutabillis) and kañiwa (Chenopodium pallidicaule) flours on cookie quality

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Abstract

The global cookie market is in constant reformulation and reassessment. This behavior has primarily been driven by changing consumer expectations. Lupine (*Lupinus mutabillis*), and kañiwa (*Chenopodium pallidicaule*) are native food crops grown in the Andean region and used as food by the Incas and previous cultures. The nutritional value of these plants is related to the high protein, dietary fiber, mineral, and vitamin content of the seeds. The main objective of this work was to evaluate the effect of the partial substitution of wheat flour with lupine (*Lupinus mutabillis*) and kañiwa (*Chenopodium pallidicaule*) flours on cookie quality. A mixture design approach was used to determine the interaction effects of the three flours with the following content restrictions: wheat 40-70% (WF), lupine 10-20% (LF), and kañiwa 20-40% (KF). The response variables were the spread factor (SF, shape characteristic), the fracture point (FP, texture characteristic), and the protein content (PC, nutritional characteristic) of the cookies. Formulations with higher wheat flour content showed greater SF values and resistance to fracture (high FP values). These results are related to gluten proteins and microstructure characteristics that gluten confers to the dough matrix. On the other hand, the formulations with higher content of Andean crops flours generated higher SF values, followed by an increased content of great nutritional value proteins. Cookies

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showed an adequate shape and nutritional benefits of the Andean flours instead of wheat. The optimum cookie formulation was 40% WF, 20% LF and 40% KF, getting the highest desirability value (0.778). These results show the aptitude of kañiwa and lupine flours to be used to develop cookies with acceptable technological features, high replacement values, and improved nutritional qualities.

Keywords: Mixture design, Andean crops, Desirability, Optimization