ID: 2018

Optimization of the Formulation of a Couscous Made from Durum Wheat/Barley - Experimental Design Method

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ABSTRACT

Barley (Hordeum vulgare L.) is an excellent source of bioactive substances. The effect of incorporation of barley semolina on couscous quality was evaluated by using simplex-lattice. The main objective of this study is to optimize a cooking properties and productivity of couscous making with durum wheat (A) and barley semolina (B). Swelling index (SI %), delitescence degree (DD %) and productivity (P %) of eight (08) formulations of couscous were evaluated. The correlations are reasonably good, with R^2 values of 0.9438, 0.9965 and 0.9704 for (P %), (SI %), and (DD %) respectively. Regarding these results, optimal preparation can be classified as good technological and cooking quality.

Keywords: Barley; couscous; optimization; productivity; cooking.

1 Introduction

Barley, which used to be a staple food alongside durum wheat in Algerian cuisine, has lost its important place due to several factors that have disrupted culinary habits[1]. Today, barley is experiencing a renewed interest, particularly for the production of functional foods due to its high content of bioactive compounds such as β-glucan[2]. Among the culinary traditions based on barley in Algeria, couscous was the basic cereal preparation of the Berbers even before the arrival of Arab populations. While wheat couscous is consumed today, barley was once the star ingredient [1]. Unlike wheat, relatively little research has been devoted to the development of a range of food products based on barley[3]. This work is a contribution to the valorization of barley in the preparation of couscous, considered the favorite dish among Algerian families on various occasions. The main objective of the study is to evaluate the effect of substituting durum wheat semolina (Triticum durum.desf.) with barley semolina (Hordeum vulgare.L) at different percentages on the productivity and culinary quality of couscous and to determine the optimum percentage of barley semolina to incorporate that allows us to obtain a mixed couscous of technological and culinary quality acceptable by adopting the simplex lattice mixture design.

2 Experimental

The barley (Hordeum vulgare. L.) variety (Rihane 03), widely cultivated in Algeria with a thousand grain weight and hectoliter weight of 46.50 g and 60.60 kg/hl, respectively, was provided by ITGC EL HARRACH (Technical Institute of Large Crops). Dry milling of barley was carried out using a Brabender Quadrumat® Junior test mill (particle size of barley semolina obtained was between 180µm-450µm in diameter). The software Expert-Design 7.0.7 trial software (Stat-Ease Inc. Minneapolis, MN, USA) is used to carry out the mixture design and analyze the results. In our study, the two-component simplex lattice mixture design was adopted to determine the optimal formulation of mixed semolinas (durum wheat/barley) used in couscous preparation. The controlled variables are the durum wheat semolina (A) and the barley semolina (B), and the selected responses are the productivity (P%), the swelling index (SI%), and the disintegration degree (DD%) of the couscous. Significant factors (probability less than 5%) were determined by conducting an analysis of variance (ANOVA) on the experimental results.

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DOI: 10.21467/abstracts.169 ISBN: 978-81-970666-4-1 (eBook)

3 Results and discussion

reported in the literature Durum wheat semolina has a higher moisture content compared to barley semolina which was obtained without conditioning the barley. The protein and total fiber rates of barley semolina are (11.80±0.3 and 12.40±0.5) respectively, these values are comparable to those reported in the literature. The protein levels of durum wheat and barley semolina are similar; however the ash and total fiber levels are higher for barley semolina, due to the presence of hulls known for their richness in fiber and minerals. The integrity of couscous particles is evaluated by the degree of disintegration. Good quality couscous disintegrates little . Couscous containing barley has higher degrees of disintegration than 100% durum wheat couscous, this could be due to the high percentage of fine particles lost during the analysis. The degrees of disintegration (DD%) recorded for the mixed couscous (Fig.1) remain satisfactory compared to those (4.62-6.16%) for artisanal durum wheat couscous .The 100% durum wheat couscous has a high swelling index, indicating its firmness compared to couscous containing barley.Statistical modelling was used to optimize the mix of durum wheat and barley semolina to maximize couscous productivity and quality. The optimal formulation was predicted to contain 66% durum wheat and 34% barley.The optimized couscous formulation was produced and analyzed. It had higher fiber than the 100% durum wheat control while maintaining satisfactory culinary properties, particle size distribution and yield.

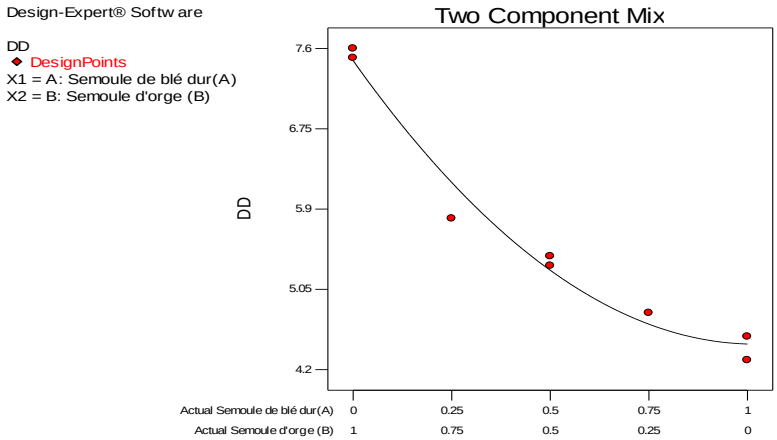

Figure1: The degrees of disintegration (DD%) of the mixed couscous

4 Conclusions

Replacing durum wheat semolina with barley semolina leads to changes in couscous productivity and its culinary properties. Thanks to the application of the simplex lattice mixture design for optimizing productivity and culinary properties of a durum wheat and barley-based couscous, significant models with a good level of predictability have been developed. The coefficient of determination R2 values also confirmed the high degree of correlation between the observed and predicted values. The optimization study revealed that 34% of durum wheat semolina could be replaced by barley semolina without degradation of the culinary quality of artisanal couscous and with a satisfactory yield. To better meet the increasing demand for health-beneficial products, we suggest reproducing these results on an industrial scale.

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ISBN: 978-81-970666-4-1

Series: AIJR Abstracts

DOI: 10.21467/abstracts.169