

Hydration kinetics and changes in some physical properties of wheat kernels

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Abstract

Hydration characteristics of wheat kernels was studied at different soaking temperatures. Some physical properties were also evaluated as a function of soaking temperature in the range of 25 to 65 °C. Five models for describing the soaking behaviour of wheat kernels were investigated. Among them, Page model was found to be the most suitable for describing the soaking behavior of wheat kernels. Effective diffusivity of water during soaking of wheat kernels varied from 2.80×10^{-12} to 1.36×10^{-11} m²/s with an activation energy of 34.26 KJ/mol. In the soaking temperatures from 25 to 65 °C, studies on soaked samples showed that the kernel density decreased linearly from 2458.18 to 985.58 kg/m³ and porosity also decreased linearly from 72.33% to 27.55%, while kernel volume increased linearly from 0.022 to 0.066 cm³. A quadratic relationship between bulk density and soaking temperature of wheat kernels was developed. The amount of solids leached increased with temperature particularly for higher soaking temperatures.

Keywords: Density; Hydration kinetics; Modeling; Moisture diffusivity; Water uptake; Wheat kernel.

Introduction

Cereals and legumes are important sources of functional ingredients which are potential components for many processed foods. Processing of cereals and legumes often requires that the seeds be hydrated first to facilitate operations such as cooking or canning. Thus, absorption of water to these materials is of both theoretical and practical interest to processing industries [1,2]. Wheat is one of the major staple foods in all over world because of its agronomical adaptability; ability of its flour to be made into various food materials and ease of storage. In the malting process, carefully selected barley is soaked in water at about 17 °C until saturation before germination [3]. Recently,

production of wheat malt or cereal mixture other than barley has initiated in some countries [3]. Adding water is also a pretreatment for the flour milling process (tempering). Tempering is a wheat moistening process that enhances milling efficiency. Control of this process may be improved with better knowledge of the distribution and movement of moisture within the wheat kernel. In tempering, temperature, variety, kernel size, and time of exposure affect the rate at which moisture enters into the wheat kernel. Among these factors, temperature has been shown to have the greatest effect, with an increase in temperature resulting in an increase in the rate of moisture absorption.

From a processing and engineering point of view, one is interested not only in knowing how fast the absorption of water can be accomplished, but also how it will be affected by processing variables [4], and also how one can predict the soaking time under given conditions. Thus, quantitative data on the effect of processing variables are necessary for practical applications to optimize and characterise the soaking conditions.

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سنتیک هیدراسیون و تغییرات برخی خواص فیزیکی دانه گندم

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خلاصه

خواص هیدراسیون دانه های گندم در دماهای مختلف خیساندن، مطالعه گردید. برخی ویژگی های فیزیکی به عنوان تابعی از دمای خیساندن در دامنه حرارتی ۲۵ تا ۶۵ درجه سانتی گراد نیز، ارزیابی شدند. پنج مدل جهت توصیف رفتار خیساندن دانه های گندم، مورد بررسی و تحقیق قرار گرفتند.

در میان آنها، مدل Page، مناسب ترین مدل جهت توصیف رفتار خیساندن دانه های گندم مشخص گردید. ضریب انتشار مؤثر آب حین خیساندن دانه های گندم با انرژی فعال سازی ۳۴/۲۶ کیلوژول بر مول 10^{-12} تا $2/80 \times 10^{-11}$ متر مربع بر ثانیه متغیر بود در دماهای خیساندن از ۲۵ تا ۶۵ درجه سانتی گراد، مطالعات بر روی نمونه های خیسانده، نشان داد که دانسیته دانه بصورت خطی از ۲۴۵۸/۱۸ به ۹۸۵/۵۸ کیلوگرم بر متر مکعب و تخلخل نیز بصورت خطی از ۷۲/۳۳٪ به ۲۷/۵۵٪ کاهش یافت، در حالیکه حجم دانه یک افزایش خطی از ۰/۰۲۲ به ۰/۰۶۶ سانتی متر مکعب داشت. یک رابطه درجه دوم بین دانسیته توده و دمای خیساندن دانه های گندم توسعه یافت. میزان مواد جامد خارج شده با افزایش دما به خصوص در دماهای بالاتر خیساندن، افزایش یافت.

کلمات کلیدی: دانسیته، سنتیک هیدراسیون، مدلینگ، ضریب انتشار طوبت، جذب آب، دانه گندم.

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