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# MANUFACTURE OF FUNCTIONAL BISCUIT FROM RICE FLOUR FORTIFIED WITH DEXTRAN

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## ABSTRACT

**The objective of this study is to investigate the impact of substituting wheat flour with rice flour and fortifying it with varying concentrations of dextran in the mixtures utilized for biscuit production. Additionally, the study aims to examine the flakiness and qualitative features of the resulting biscuits. The findings indicated that there was a positive correlation between the percentage of dextran and the diffusion coefficient of the biscuits. Specifically, the diffusion coefficient increased as the percentage of dextran increased. For instance, the diffusion coefficient reached 10.8 cm when the biscuits were treated with a 3.5% replacement of dextran, and it further increased to 12.8 cm when the biscuits were treated with a 5% dextran replacement. Regarding sensory evaluation, the dextran therapy with a concentration of 3.5% achieved a score of 87.5%, in comparison to the treatment with a concentration of 0%. The acquired score was 78.6%, while the score for the therapy with 5% dextran was 91.2%. Hence, when evaluating the nutritional content and qualitative and sensory features of the biscuits concurrently, it can be concluded that the treatments including 3.5% and 5% dextran exhibit superior performance and may be regarded as the optimal choices.**

**Keywords:** Dextran, Rice flour, biscuits, Celiac disease.

## تصنيع البسكويت الوظيفي من دقيق الأرز المدعم بالدكستران

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### الخلاصة

**الهدف من هذه الدراسة هو معرفة تأثير استبدال دقيق القمح بدقيق الأرز وتدعيمه بتراكيز مختلفة من الدكستران في قالخلطات المستخدمة لإنتاج البسكويت. بالإضافة إلى ذلك، تهدف الدراسة إلى فحص مدى التقشر والخصائص النوعية للبسكويت الناتج. أشارت النتائج إلى وجود علاقة إيجابية بين نسبة الدكستران ومعامل الانتشار للبسكويت. على وجه التحديد، زاد معامل الانتشار مع زيادة نسبة الدكستران. على سبيل المثال، وصل معامل الانتشار إلى 10.8 سم عندما تمت معالجة البسكويت بإضافة الدكستران 3.5%، وزاد أيضًا إلى 12.2 سم عندما تمت معالجة البسكويت بإضافة الدكستران بنسبة 5%, وفيما يتعلق بالتقييم الحسي، حقق العلاج بالدكستران بتركيز 3.5% درجة 87.5%، مقارنة بالمعاملة بتركيز 0%. وكانت النتيجة المكتسبة 78.6٪، في حين كانت النتيجة بإضافة الدكستران بنسبة 5٪ 91.2٪. وبالتالي، عند تقييم المحتوى الغذائي والخصائص النوعية والحسية للبسكويت في وقت واحد، يمكن استنتاج أن المعالجات التي تشمل 3.5% و5% دكستران تظهر أداءً متفوقًا ويمكن اعتبارها الاختيارات الأمثل.**

**الكلمات المفتاحية:** دكستران، دقيق الأرز، البسكويت، مرض الاضطرابات الهضمية.

## INTRODUCTION

Celiac disease is a chronic autoimmune disorder that predominantly affects the small intestine **(Penagini *et al.*,2013**) leading individuals to acquire an intolerance to gluten, which is found in many dietary sources like wheat and barley. (**Molina *et al.*, 2015)** Common symptoms of this condition encompass gastrointestinal issues, including persistent diarrhea and abdominal distention **(Ludvigsson *et al.*, 2015)**. Children may experience malabsorption **(Cichewicz *et al.*, 2019)**, a decrease in appetite, and an inability to thrive **(Vivas *et al.*, 2015)**. The onset of this phenomenon often occurs during the age range of six months to two years **(Abdul-Rahman *et al.*,2023)**. Non-classic symptoms are frequently observed, particularly among those aged two years and above. There is a possibility of mild or negligible gastrointestinal symptoms, a diverse range of symptoms affecting several body parts **(Lionetti *et al.*, 2015),** or the absence of apparent symptoms Celiac disease was initially documented during childhood; yet, it has the potential to manifest at any stage of life**.( Hischenhuber *et al.*, 2006)** This condition is commonly linked to other autoimmune disorders, including Type 1 diabetes mellitus and Hashimoto's thyroiditis **(Lewis & scott, 2006)**. Baked foods, such as biscuits, can be characterized as intricate emulsion systems consisting of a combination of fat and water, alongside other essential ingredients such as sugar, eggs, breadcrumbs, and wheat. This particular substance is abundant in lipids, and proteins, and serves as a significant source of energy flour was employed as a viable alternative to wheat flour in the production of various baked items, particularly cakes. rice is widely recognized as a prevalent grain within the Middle East and Arab nations **(Ciccocioppo *et al.*, 2015)**, serving as a significant energy provider due to its high content of carbs, proteins, and minerals **(Husby *et al.*, 2012)** This ingredient finds application in the production of several bakery items, including cookies, cupcakes, and loofah bread. The objective of this research is to present an alternative food product that can serve as a replacement for wheat flour. This substitute will be enhanced with dextran, a colloidal material that plays a crucial role in preserving the structure of baked goods and enhancing their sensory attributes. This product caters to the requirements of those with gluten sensitivity, as baked foods, such as cakes, are abundant in energy, lipids, and proteins, also rice is a valuable source of minerals and vitamins **(Agu *et al.*, 2007)**

## MATERIALS AND METHODS

### Preparation of rice powder and dextran:

The rice samples, namely Indian Basmati rice, were subjected to grinding using a laboratory mill, which was manufactured by the Kenwood business. The experiments were conducted in the laboratories of the Department of Food Sciences within the College of Agricultural Engineering Sciences. Basmati rice grains are classified as high in amylose, which gives them more distinctive cooking qualities than Iraqi rice (amber), which is one of the waxy varieties (high in amylopectin). Dextran was obtained by extraction from a local isolate of bacteria *Weissella cibaria*.

The flour underwent a process of filtration using a sieve with a diameter of 0.4 mm. Subsequently, the flour samples were stored in polyethylene bags under refrigerated conditions at a temperature range of (5±2°C) until they were subjected to laboratory analysis.

**Preparing gluten-free biscuits**

**Ingredients and mixing method.**

The biscuit making performances were determined using the American Association of Cereal Chemists (AACC,2000) method No.(10-50B) with some modification, the wheat flour was replaced with rice flour powder according to the following table (1):

**Table (1)** Rice biscuit mixes fortified with dextran.

| Material | Weight(gm) | Standard mixture (wheat flour/g) |
|---|---|---|
| Rice flour | 225 | 225 |
| vegetable oil (Margarine) | 64 | 64 |
| Backing powder | 2.5 | 2.5 |
| table salt | 2.1 | 2.1 |
| Water | 24 | 16 |
| Ground sugar | 130 | 130 |
| dextran | 1.5,2.5,5% | --- |

**The process that was employed**

Creamed the dry ingredients (sugar and fat) in the bowl of a Kenwood mixer using the whip attachment for only three minutes to form a smooth cream (skimming), then I added water, and the ingredients were mixed for two minutes, and finally, I added the rice powder and the rest of the dry ingredients (salt and soda) and continued mixing for Only one minute, when scattered (in cohesive) lumps of dough are formed. They are spread on parchment paper between two glass plates 6 mm thick using a wooden roller, and then the dough is cut, after moving away from the edges (scraps) by about 0.5 cm, into 6 pieces ( Discs) using a cookie cutter with a diameter of 60 mm, and after removing the ends, the roasting process was done in the oven at a temperature of 175 °C for 10 minutes, then left to cool to room temperature within 60 minutes.

**The particular subject of debate relates to biscuit transactions.**

The experimental investigation utilized rice flour that has been enriched with dextran (from locally isolated bacteria *weissella cibaria*). The product being investigated was subjected to several procedures, which are outlined as follows:

The initial treatment (T1, referred to as the control treatment) comprises rice flour combined with the fundamental ingredients, without any further additives.

The second treatment, denoted as T2, involves the utilization of rice flour as the primary component, supplemented with basic ingredients, along with the inclusion of 1.5% dextran per 100 g of flour.

The third treatment, denoted as T3, involves the incorporation of 3.5% dextran per 100 g of rice flour, in addition to the fundamental ingredients.

The fourth treatment, denoted as T4, involves the incorporation of rice flour with the fundamental constituents, along with the inclusion of 5% dextran per 100 g of flour.

**The examination of physical attributes by empirical methods.**

**Estimating the percentage of weight loss after grilling:**

The water content lost after grilling the biscuits was estimated by applying the following rule:

Moisture loss (%) = (weight of biscuits before baking - weight of biscuits after baking)/weight of biscuits before baking x 100

**The diffusion coefficient**

The method of AACC (2000) was followed for evaluation of biscuits width , thickness and then spread factor. Biscuits width (W) was measured by placing six biscuits edge to edge and get the average width in cm. Biscuits thickness (T) was measured by putting the same biscuits on top of each another and measure in cm.

$$Spread\ ratio\ = \frac{The\ average\ width\ (W)\ of\ six\ biscuits}{The\ average\ thickness\ (T)\ of\ six\ biscuits}$$

$$Spread\ factor\ = \frac{Spread\ ratio\ of\ sample}{Spread\ ratio\ of\ control\ sample} \times 100$$

**The evaluation of biscuits**

The evaluation of biscuits was conducted by a panel of ten expert evaluators affiliated with the College of Agricultural Engineering Sciences, specifically the Department of Food Sciences. The evaluation focused on assessing the qualitative attributes of the biscuits, including their outer appearance, softness, color, taste, and texture. The evaluation procedure followed a method that had been approved by a relevant authority, referenced **(Al-Mihyawi, 2018)** and the results were recorded in a tabular format.

## RESULTS AND DISCUSSION

Table (1) indicates the widespread values and product parameters of rice flour biscuits for the four treatments (B0 = control, B1 = control + 1.5% dextran, B2 = control + 3.5 dextran, B3 = control + 5% dextran), as the results of the widths of 6 sheets of biscuits were 26.4, 27.0, 25.8, and 26.8 cm respectively. The differences between the treatments were not significant. **(Kazim *et al.*, 2012)**, As for the thickness of the 6 biscuit discs, they were 3.0, 2.6, 2.4, and 2.2 cm. These values showed significant differences at the level of probability, respectively, between the four treatments **(Al-Aubadi & Al-Jobouri, 2013)**, These results were reflected in the values of the biscuit diffusion coefficient, as they were 8.8, 10.4. It helps retain water during the baking process, and this is observed in the decrease in the rate of water loss with an increase in the concentration of dextran. **(Mousa *et al.*, 2019)**.

**(Table 1):** The physical parameters and percentage of moisture loss of gluten-free rice biscuits added to dextran at three different concentrations are under study.

| Characteristics/Treatment | B0 | B2 | B3 | B4 |
|---|---|---|---|---|
| Width (cm) | 26.4 | 27.0 | 28.5 | 26.8 |
| Thickness (cm) | 3.0 | 2.6 | 2.4 | 2.2 |
| Diffusion coefficient(cm) | 8.8 | 10.4 | 10.8 | 12.2 |
| moisture loss after grilling% | 33.2 | 22.5 | 19.1 | 15.0 |

(B0)= control treatment. (B2)= 1.5% dextran added from flour. (B3)= 3.5 % dextran added from flour. (B4)= 5% dextran added from flour.

Food hydrocolloids are able to form polymeric networks, including dextran, on the outer surface and inside the food tissue, which works to retain water during and after baking (**Ahmaed *et al.*,2015).** I use the diffusion coefficient index to determine the quality of flour used in preparing biscuits and the ability of biscuits to rise The higher its value, the more desirable it is, Therefore, it can be concluded that adding dextran increased the diffusion coefficient compared to the control treatment **(Mousa *et al.*, 2019)**; **(Al-Mhyawi, 2023)**.

**Sensory evaluation questionnaire for conventional biscuits**

(Table, 2) shows the sensory characteristics of rice biscuits produced from the four treatments, which are the external characteristics (diffusion coefficient, external appearance, shape uniformity, nature of cracking on the top surface, and tenderness), and the internal characteristics (pulp color, taste, and flavor). All treatments showed significant differences in the external and internal attributes compared to the control treatment (B0), as it is noted that all attributes improved, especially the increase in residents' acceptance of biscuits with the increase in the percentage of added dextran **(Al-Ziady & Hussain, 2023)**, expressed as the total score awarded compared to the treatment. the control, Based on this, biscuits produced with the addition of 5% dextran can be considered the best sensory-wise. The increased amount of softness with a higher rate of dextran addition compared to the control treatment is due to the high ability of dextran to bind water, and this is due to the nature of its chemical composition, despite the large surface area and low thickness of the biscuit disc, and this is what **(Al-Ali, 2018)** pointed out. improve the properties of baked goods to which dextran is added, and one of these factors is water absorption, which is directly related to the positive increase in the productivity of baked goods, despite what results from the high dehydration rate resulting from heating and associated with the loss of water from starch granules and protein compounds, which It increases with the large flat area and thin thickness characteristics of the biscuits. **(Nashmi & Naser, 2022)**

**Table (2):** Sensory evaluation of the standard biscuits being examined.

| Attributes | Degree (%) | B0 | B1 | B2 | B3 |
|---|---|---|---|---|---|
| External appearance and uniformity of form | 20 | 15.0 | 16.9 | 17.2 | 18 |
| The nature of the cracking of the upper surface | 10 | 7**.0** | 7.4 | 8.1 | 8.8 |
| Freshness | 10 | 8**.0** | 8.3 | 8.8 | 9**.0** |
| Taste and flavor | 20 | 15.6 | 17**.0** | 17.8 | 18.1 |
| Pulp color | 10 | 7.3 | 8.1 | 8.5 | 8.9 |
| Diffusion coefficient | 30 | 25.7 | 26.3 | 27.1 | 28.4 |
| Total | 100 | 78.6 | 84 | 87.5 | 91.2 |

(B0)= control treatment. (B1)= 1.5% dextran added from flour. (B2)= 3.5 % dextran added from flour. (B3)= 5% dextran added from flour.

## CONCLUSION

This study showed the possibility of manufacturing functional biscuits from basmati rice flour fortified with dextran gum as one of the solutions for feeding patients with celiac disease (gluten allergy). The results showed an improvement in the size and diffusion coefficient of the biscuits with an increase in the addition of dextran, along with a decrease in the percentage of water loss, which gave it high softness, compared to the control treatment without additives. The judges' acceptability of biscuits fortified with dextran increased as the softness of the biscuits increased and the taste and flavor improved with the increase in the substitution rate. Providing alternative and natural sources of glues used in the manufacture of foods for special groups is an aspect with two dimensions: health for patients and economic aspect, by moving the wheel of the market. Thus, these additives manufactured from the waste of natural organic industries are safer than those produced through chemical industries.

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