J. Agr. Sci. Tech. (2015) Vol. 17: 135-144

Impact of Pretreated Rice Bran on Wheat Dough Performance and Barbari Bread Quality

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ABSTRACT

In this research roasted and sonicated rice bran were added at different levels (0, 5, 10, and 15% w/w) to wheat flour for the production of semi-voluminous bread. Dough's rheological properties as well as textural and sensory characteristics of bread were investigated. The results showed that water absorption (%), development time (min) and the degree of dough softening (FU) were increased but dough stability (min) was decreased by adding pretreated rice bran. Adding pretreated rice bran increased the moisture content and *L value of bread crust. The texture of samples which contained 10% pretreated rice bran during 3 hours after baking was less stiff than the control. However, there was no significant difference between samples which contained 5, 10% of rice bran and the sample without rice bran (P< 0.05) 48 hours after baking. Finally, the samples with 10% rice bran were selected as the most productive samples in this research by panelists.**

Keywords: Barbari bread, Rice bran, Roasting, Ultrasound.

INTRODUCTION

Bread is the main food throughout the world especially in the Middle East. Rice bran in high amounts is one of the most available and cheapest fiber sources in Iran and is available as a waste. Rice bran contains high amounts of protein, fats, vitamins, minerals as well as antioxidants and hence can be utilized for enriching food products (Majzoobi *et al.* 2013).

The rice bran is able to retain moisture in products of baking industries especially bread because of its water absorption ability. Also it increases retention of air and finally dough leavening by producing foam. On the other hand, the presence of sugar compounds in rice bran (3-8%) can play a key role in browning and better color formation in baked products (Baqeri and Seyyedin, 2011).

Stabilization is the first step in using rice bran in food stuffs. As Carol (1990) mentioned the main methods of rice bran stabilization for destroying enzymes which make the product tangy are extrusion process and thermal stabilization (roasting). Nowadays, new methods such as ultrasonic waves are used for the destruction of enzymes (Sheykhol-Eslami, 2009). Stabilized rice bran can be used for making some qualitative and quantitative features better along with increasing nutritional value in baked products.

Baqeri and Seyyedin (2011) studied the efficiency of rice bran at various levels (5, 10, 15, and 20%) and found that the amount of dough's water absorption was increased but its stability against tension was reduced by adding the bran to the formulation. The

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authors introduced the sample contained 10% rice bran as the best sample in terms of quantity and quality.

Sairam *et al.* (2011) also studied the efficiency of fat-free rice bran at the levels of 5, 10 and 15% in bread formulation. According to their results, the samples including 5 and 10% of this fiber resource had long-lasting quality and high acceptability. On the other hand, Ghufran *et al.* (2009) found that by adding rice bran to bread formulation at 2-20% levels, the texture score and samples' taste checked by panelists were decreased. Among these samples, the sample which contained 10% rice bran and 90% wheat flour had higher acceptability than other samples.

Sekhun *et al.* (1996), AbdolHamid and Levan (2003) and Sangrak *et al.* (2004) studied the efficiency of adding rice bran on specific volume of baked products and reported that this parameter was decreased by adding rice bran to formulation.

Thus, the present research aimed at investigating the effect of the addition of pretreated rice bran under two processes, by heating (roasting) and sonication, on wheat dough performance and barbari bread quality.

MATERIALS AND METHODS

Wheat flour was purchased from Golmakan Flour Factory in Mashhad, Iran and contained 13.6% moisture, 10.3% protein, 0.64% ash, 1.1% fat, 0.51% crude fiber, 26.7% wet gluten and falling number of 402 seconds all determined according to the approved methods of the AACC (2000). Rice bran was provided one a company in Mazandaran Province, and contained 14% protein, 20% fat, 9.8% ash and 25% raw fiber. Active dry yeast (*Saccharomyces cerevisiae*) which was a dry and active powder in vacuum packing was bought from Razavi Yeast Factory in Mashhad, Iran. Salt, sugar and oil were purchased from the local market.

Pretreatment of Rice Bran

Raw rice bran was milled by means of a laboratory mill (Alexander Wreck model WEL82, Germany) and then manually sieved at 20 mesh. After milling, the raw rice bran was roasted for 10 minutes at 100°C in an oven (Jeto Tech brand, OF-O2G model, Made in Korea) to investigate lipase and reduce its moisture content to a value lower than 10% (Carol, 1990).

For sonication, a set which produced ultrasonic waves (UP200 H, Hielscherm, Germany) made in was used. The linear mechanical oscillation with 24,000 frequencies/second (24 kHz) for 5 minutes by sonotrode (model S3) was used for pretreated rice bran.

Bread Making Method

First, all dried raw materials were mixed in a mixer (Spiral model, made in Thailand) and the required amount of water was added for each treatment (Table 1). Then the dough was mixed for 10 minutes at 150 rpm and on the sixth minute, the formulation oil was added into the formulation after composing the main texture of dough. The first stage of fermentation happened for 30 minutes at ambient temperature (25°C). After that the dough was divided into 250 g pieces. Then these divided pieces were left at ambient temperature for 8-10 minutes for the second stage of fermentation. The final stage of

Table 1. Compounds used in formulation of barbari bread.

Compounds	Amounts (%)
Wheat flour	85-100
Roasted rice bran	5, 10, 15
Ultrasonic rice bran	5, 10, 15
Water	According to farniograph results
Yeast	1
Salt	1
Sugar	1
Oil	1

[DOR: 20.1001.1.16807073.2016.18.1.19.7]

fermentation occurred in a rotary oven with hot air (Zuccihelli Forni, made in Italy) at 260°C within 13 minutes. After cooling, each sample was packed in polyethylene bags for qualitative and quantitative characteristics assessments and was kept at ambient temperature. It is necessary to mention that the control sample lacked rice bran.

Rheological Properties of Dough

This test was done on the basis of approved methods of the AACC (2000), 54-21 and by farinograph set, Brabender model, and a mixer with 300 g capacity.

Moisture Measurement

Moisture of each sample was determined by oven (MX-50 A and D Co. Limited, Tokyo, Japan) drying at 105°C until constant weight was reached.

Evaluation of Specific Volume of Bread

Specific volume of samples was determined by rapeseed displacement (AACC, 2000).

Evaluation of Porosity of Bread Crumb

Porosity of bread crumb was measured as described by Ghufran *et al.* (2009) by image processing technology. At first, a slice of bread core with dimensions of 4×4 centimeters was prepared and imaged by a scanner (HP Scan jet G3010 model) at 300 dpi pixel resolution. Then the images were opened in Image J software. The gray level images were formed by activating the 8 bit part of software. And for changing the gray images into the binary images, the binary part of software was activated. These images contained some bright and dark spots and the bright-to-dark ratio was estimated as porosity index of samples. It is obvious that a higher ratio means more porosity in bread texture. The samples' ratio and percentage of these porosities were measured by software analysis. It is necessary to mention that this analysis was done 3 hours after baking.

Textural Properties of the Bread

Texture characteristic of the bread was assessed by means of a texture analyzer (QTS, CNS Farnell, UK). The necessary power for penetrating into each sample by a probe with a flat end (2.5 centimeter width and 1.8 centimeter height) with speed of 30 millimeter per minute was measured by this texture analyzer (Trigger value: 0.05 N, Target value: 30 mm) (McCarthy *et al.,* 2005).

This test was done 3 and 48 hours after keeping the samples at ambient temperature and the measured parameter in this test was the firmness of bread core.

Evaluation of Bread Crust Color

The color parameters of *L* (lightness), a (greenness-redness) and b (blueness yellowness) of the bread were assessed according to Sudha *et al.* (2007). At first, the slice of bread crust with the dimensions of 4×4 centimeters was prepared and imaged by a scanner (HP Scan jet G3010 model) at 300 dpi pixel resolution. Then the images were opened in Image J software. The above values were calculated by using the LAB space in Plugins section.

Evaluation of the Sensory Characteristics of Bread

The sensory characteristics of prepared bread were examined on the basis of 5 point hedonic method. These characteristics were evaluated by 10 trained panelists and they reported their results on the basis of total acceptability, which was the sum of score

[DOR: 20.1001.1.16807073.2016.18.1.19.7]

parameters such as texture, core color, crust color, taste, and flavor and aroma 3 hours after baking.

Data Analysis

The results of this research were randomly evaluated by Mstat-c software version 1/42. The averages of each variable, which were examined three times, were compared by Duncan's test at 5% level.

RESULTS AND DISCUSSION

Farinograph Properties of Dough

Water Absorption

As shown in Figure 1-a, the water absorption of samples was significantly increased as compared with the control (P< 0.05) by increasing the percentage of bran (roasted and sonicated). The least water absorption was related to control whereas the highest water absorption belonged to two samples containing 15% bran (roasted and sonicated). Water absorption increase is caused by the presence of hydroxyl groups in additives (Haralick *et al.,* 1973). Rosell *et al.* (2001) pointed that there were many hydroxyl groups in fiber structures (such as rice bran) which caused water absorption to increase with producing hydrogen bonds (Randall et al. 1985). The results of the mentioned research were similar to those of Milani *et al.* (2006) and Sudha *et al.* (2007) that examined the efficiency of pretreated rice bran addition to flour and concluded that this addition caused water absorption increase in farinogram.

Dough Development Time

As shown in Figure 1-b, dough development time of samples was significantly increased rather over control (P< 0.05) by adding bran (roasted and sonicated). The results indicated that the effect of roasted rice bran was more than that of sonicated bran on the duration of dough puffing. Also, the conclusions explained that the least time of dough development was related to control (2.23±0.06 minutes) and the most time of this parameter (3.63±0.26 minutes) belonged to the sample containing 15% roasted rice bran. Sahraeeyan *et al.* (2012), Kuchaki *et al.* (2011) and Milani *et al.* (2006) in their researches about bread industries products pointed that water absorption increase resulted in enhancing the duration of dough development which was in accordance with the present research.

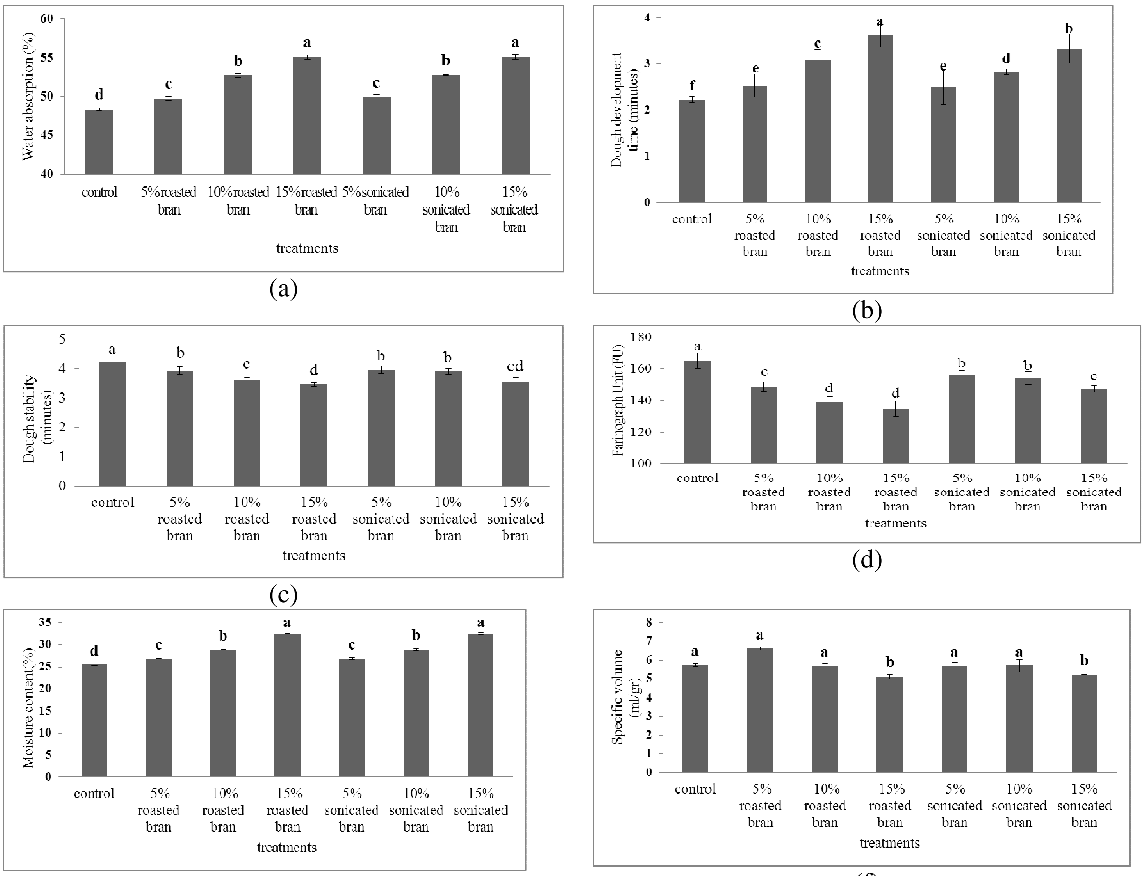
Dough Stability

As shown in Figure 1-c, dough stability of samples compared with control was significantly decreased (P< 0.05) by increasing the bran percentage (roasted and sonicated). The results of this research also were in accordance with that of Gharib Bibalan *et al.* (2011) who investigated the efficiency of rice bran addition to dough formulation at 0, 10, 20 and 30% levels and concluded that the stability of dough was decreased by adding rice bran to the formulation. The present research also showed that the least stability of dough was related to the samples containing 15% roasted rice bran (3.45±0.06 minutes) whereas the highest value of this parameter (4.20±0.10 minutes) was related to control. Generally, the dough stability against mechanical factors will be decreased because of damages imparted to the gluten structure by adding rice bran or any fiber resource into the formulation of the products of bread industries (Carrol, 1990).

Dough Softening Degree

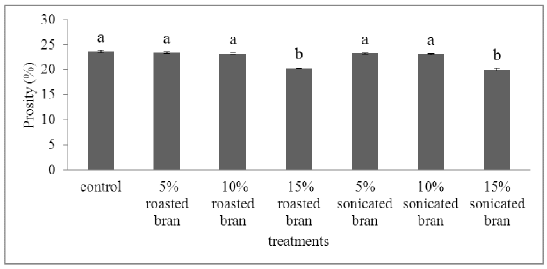
Dough softening degree was significantly reduced over control (P< 0.05) by adding the bran (roasted and sonicated) as shown in Figure 1-d. Also, the decrease of this

[DOR: 20.1001.1.16807073.2016.18.1.19.7]



(a) (b) (c) (d) (e) (f)

Figure 1. Effect of adding different amounts of rice bran on (a) dough water absorption, (b) dough developmental time, (c) dough stability, (d) dough softening, (e) moisture content of bread, (f) specific volume of bread, (g) porosity of bread.



(g)

parameter in roasted rice bran samples was considerably higher rather than sonicated rice bran samples. Gharib Bibalan *et al.* (2011) also examined the efficiency of rice bran addition at 10, 15 and 20% levels and concluded that not only dough stability but also its softening degree was reduced by adding rice bran to dough formulation. The present research resulted that the highest rate of this parameter (165.0±5.00 FU) was related to control and the least (134.70±5.03 BU) belonged to the sample containing 15% roasted rice bran but there was no significant difference between this sample (containing 15%) and the sample containing 10% roasted rice bran.

Bread Moisture Content

Figure 1-e, indicates that moisture content of all samples was significantly increased over control by adding the bran (roasted and sonicated) ($P< 0.05$). Besides, these results showed that there was no significant differences between the two kinds of

[DOR: 20.1001.1.16807073.2016.18.1.19.7]

pretreated bran at equal levels. In addition, the sample containing 15% of roasted rice bran (32.47±0.105%) and the sample containing 15% of sonicated rice bran (32.53±0.21%) had the most significant effect (P< 0.05) on increasing the moisture of final product when compared with control.

McCarthy *et al.* (2005) said that materials with hydrophilic nature could react with water and cause to reduce its distribution and increase its stability during the baking process. Because of this, the moisture content of final product increases during and after baking process. Thus, it can be said that fibers because of having hydroxyl groups in their structures and also having bondability with water molecules in formulation not only increase water absorption rate in dough but also increase the moisture content of final product.

Specific Volume of Bread

The specific volume of samples was significantly decreased over control by adding more than 10% of rice bran (roasted and sonicated) (P< 0.05) as shown in Figure 1-f. The results showed that there was no significant difference between control and samples containing 5 and 10% pretreated rice bran. In a study conducted by Sangnarak *et al.* (2004), it was reported that the volume and the specific volume of samples were reduced by fiber addition (15 g fiber per 100 g flour) to bread formulation. According to Sekhon *et al.* (1997) the bread volume was decreased because of adding more than 10% rice bran to formulation. said it was mentioned that the specific volume decrease of productive samples containing more than 10% levels is caused by considerable decrease of gluten in formulation and dough intolerance (because of reducing the gluten than control) in protecting and keeping gas cells during fermentation stage and even baking process. Milani *et al.* (2006) described that rice bran added to dough formulation decreased its elasticity which influenced reducing specific volume.

Porosity of Bread

Figure 1-g, shows that porosity rate of samples compared to control was significantly decreased by adding more than 10% rice bran (roasted and sonicated) (P< 0.05). Decreasing the gluten in formulation, disordering in keeping gas cells because of extreme water absorption by dough prepared from these treatments, inactivation of yeast and decreasing the number of gas cells could cause the porosity reduction in samples containing more than 10% rice bran. As Karimi *et al.* (2010) reported additives which extremely increased water absorption of dough through destructive effect on yeast function played important role in reducing porosity in the texture of final product.

Firmness of Bread

As shown in Figure 2-a, firmness of samples was significantly increased over control three hours after baking by adding more than 10% of rice bran (roasted and sonicated) (P< 0.05). High firmness in samples containing 15% rice bran compared to other samples resulted from decreasing gluten rate in total formulation which caused not only transfer of moisture from core to crust but also decrease of gas cells in dough texture during fermentation. On the other hand, decreasing firmness in samples containing less than 10% rice bran to control could be interpreted as though fiber components in formulation of these samples with water absorption prevent moisture loss in samples. Besides, these components could react with starch molecules and defer retrogradation in final product. Generally, many factors such as amylopectin retrogradation, rearrangement of polymers in the amorphous region, moisture reduction and moisture distribution between amorphous and crystalline regions lead to

[DOR: 20.1001.1.16807073.2016.18.1.19.7]

bread staling during storage (Milani *et al.,* 2006).

Moreover, the results of present research indicated (Figure 2-b) that there was no significant difference between the firmness rate of 5 and 10% rice bran samples and that of control 48 hours after baking while firmness rate of 15% rice bran sample at 5% level was higher than others. Seyyedin *et al.* (2011) who investigated the effect of rice bran on the texture of industrial products concluded that 10% rice bran samples had the highest quality in terms of texture.

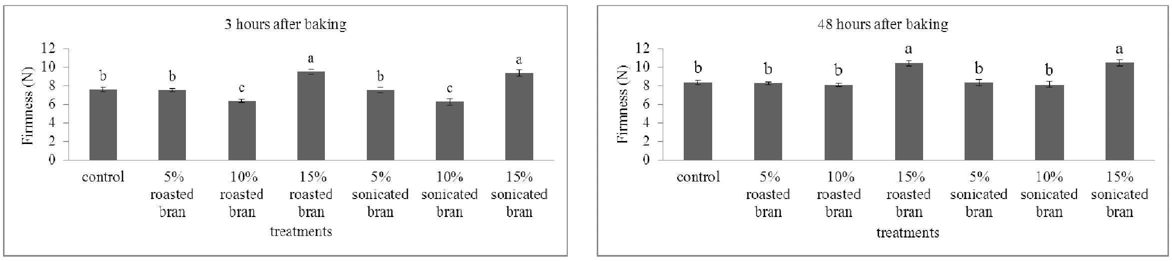
Crust Color

Figure 3-a shows that the *L** value in samples was significantly increased compared with that of control by the addition of rice bran (roasted and sonicated) ($P< 0.05$). Also, results showed that the highest value of *L** value was related to 10 and 15% rice bran samples while the least was associated with 5% rice bran sample and control.

High capacity of water holding by fiber compositions in rice bran increased *L** value. These combinations decreased the changes of bread crust surface by maintaining moisture and preventing water loss during baking process and Therefore increase this colorful item (L*). Purlis and Salvadori (2009) explained that bread surface changes controlled the brightness and smooth surface had more ability to reflect light and increase *L** value than uneven surface. On the other hand, examining the *a** and *b** values showed that there was no significant difference between rice bran samples and control.

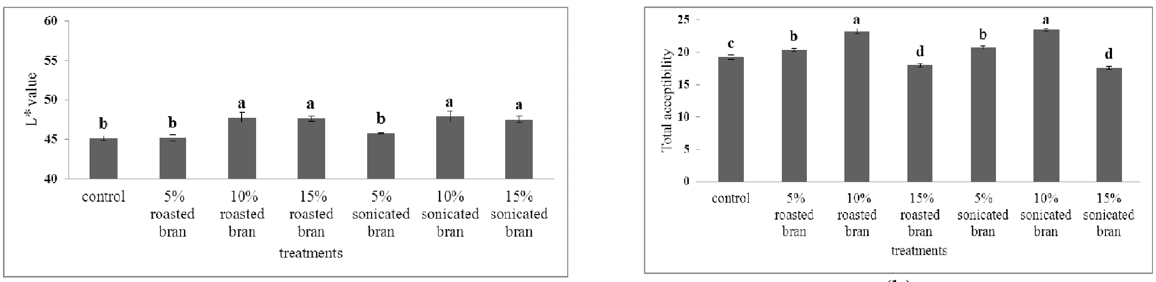
Total Acceptability

There were significant differences between different treatments and control at 5% level. Samples containing 10% rice bran (roasted and ultrasonic) received the highest score and those with 15% of this bran gained the least score in terms of total scores of sensory parameters as shown in Figure 3-b. In another study, Sairam *et al.* (2011) found that 5% and 10% rice bran samples were more acceptable than other samples by examining the effect of rice bran at 5, 10 and



(a) (b)

Figure 2. Effect of adding different amounts of rice bran on firmness of bread. (a) 3 hours after baking (b) 48 hours after baking.



(a) (b)

Figure 3. Effect of adding different amounts of rice bran on (a) *L** value of bread crust, (b) total acceptability of bread.

15% levels on bread formulation and their results were compatible with the results of this study. Bagheri and Seyyedin on the one hand by studying on rice bran samples at 5, 10, 15 and 20% levels in one bakery pointed out that only samples containing 10% rice bran had higher quality than other samples in terms of sensory characteristics. In addition, in Ghufran *et al.* (2009) study some wheat flour was replaced by rice bran and they reached the same results that samples containing 10% rice bran were more acceptable than others with different levels.

CONCLUSIONS

Rheology results obviously showed that water absorption, dough development time and dough softening degree were increased and its stability was decreased by increasing rice bran. Also, studying the qualitative and quantitative characteristics of bread indicated that moisture content and crust $L*$ value were enhanced by rice bran increase. Evaluation of the texture firmness of samples three hours after baking indicated that only samples containing 10% rice bran were less hard than control but there were no significant differences between 5, 10% rice bran samples and control 48 hours after baking. Finally, in sensory evaluation, samples containing 10% roasted or sonnicated rice bran were chosen as the best productive samples in the present research by panelists.

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[DOR: 20.1001.1.16807073.2016.18.1.19.7]

بررسی اثر افزودن سبوس برنج پیش تیمار شده بر رئولوژی خمیر و خواص کیفی نان بربری

پ. تقی‌نیا، ا. عطای صالحی، و ز. شیخ الاسلامی

چکیده

در این تحقیق سبوس برنج پیش تیمار شده با حرارت و فراصوت در فرایند تولید نان بربری در سطوح صفر؛ ۵؛ ۱۰ و ۱۵ درصد جایگزین آرد گندم شد. خواص رئولوژیکی خمیرو ویژگی های بافتی و حسی نان بررسی شد. نتایج نشان دادندکه جذب آب؛ زمان توسعه و درجه نرم شدن خمیر افزایش ولی پایداری آن کاهش یافت. مقدار رطوبت نان و شاخص L* پوسته افزایش یافت. بافت تیمارهای دارای ۱۰٪ سبوس پیش تیمار شده ۳ ساعت پس از پخت نرمتر از شاهد بود. ولی ۴۸ ساعت پس از پخت

اختلاف معنی داری بین بافت تیمارهای دارای ۵ و ۱۰٪ و نمونه شاهد مشاهده نشد. در نهایت ارزیاب های حسی نمونه دارای ۱۰٪ سبوس برنج را بهترین نمونه معرفی کردند.

[DOR: 20.1001.1.16807073.2016.18.1.19.7]