

## EFFECTS OF TURMERIC POWDER ON DOUGH QUALITY AND BREAD QUALITY

### ẢNH HƯỞNG CỦA BỘT NGHỆ BỔ SUNG ĐẾN TÍNH CHẤT BỘT NHÀO VÀ CHẤT LƯỢNG BÁNH MÌ LẠT

Nguyen Dang My Duyen, Le Tan Hoang  
Ho Chi Minh City University of Technology and Education

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#### ABSTRACT

*Turmeric (Curcuma longa L.) powder is a spice, food preservative, popular colorant in India, China and Southeast Asia. Turmeric powder was used to substitute 0.5%, 1%, 1.5% and 2% of wheat flour for making turmeric bread. Turmeric wheat dough was analyzed for gluten quality and CO<sub>2</sub> holding ability. Quality of turmeric bread was assessed through nutritional value, sensory quality and curcumin content. The quality of gluten, the CO<sub>2</sub> holding ability of dough decreased with the addition of 1.5% and 2% of wheat flour with turmeric powder. The volume of turmeric bread decreased with the increasing amount of turmeric powder added to the bread. Nutritional content of turmeric bread was not significantly different from control samples. Curcumin was found in turmeric bread. The content of curcumin increased with the addition of turmeric powder. 1% addition of wheat flour with turmeric powder showed acceptable sensory scores which were comparable to bread.*

**Keywords:** Turmeric powder; curcumin; bread; dough; sensory quality.

#### TÓM TẮT

*Bột nghệ được một loại gia vị, chất bảo quản thực phẩm, chất tạo màu phổ biến ở Ấn Độ, Trung Quốc và Đông Nam Á. Bột nghệ được bổ sung vào bánh mì lạt với các tỉ lệ lần lượt là 0.5%, 1%, 1.5%, 2% theo khối lượng bột mì. Các mẫu bột nhào có bổ sung bột nghệ sẽ được phân tích độ ẩm, chất lượng gluten và khả năng giữ khí của bột nhào. Chất lượng bánh mì thành phẩm sẽ được đánh giá thông qua giá trị dinh dưỡng, chất lượng cảm quan và hàm lượng curcumin trong bánh. Kết quả nghiên cứu cho thấy các mẫu được bổ sung bột nghệ có xu hướng thay đổi về tính chất bột nhào. Chất lượng gluten, khả năng giữ khí của bột nhào giảm khi bổ sung 1.5% và 2% bột nghệ. Theo đó, thể tích riêng bánh mì thành phẩm giảm theo sự gia tăng lượng bột nghệ bổ sung vào bánh mì. Hàm lượng dinh dưỡng trong các mẫu bánh mì chứa bột nghệ không có sự khác biệt so với mẫu đối chứng. Curcumin được tìm thấy trong các mẫu bánh mì bổ sung bột nghệ. Hàm lượng curcumin tăng khi hàm lượng bột nghệ bổ sung tăng. Mẫu bánh mì bổ sung 1% bột nghệ được ưa thích nhất do có màu vàng và mùi vị nghệ nhưng không mất đi mùi vị đặc trưng của bánh mì.*

**Từ khóa:** bột nghệ; curcumin; bánh mì; bột nhào; chất lượng cảm quan.

#### 1. INTRODUCTION

Turmeric (*Curcuma longa*) is widely used as a spice, food preservative and colorant in India, China and Southeast Asia. Curcumin is a biologically active ingredient that gives yellow color to turmeric. Studies have shown that curcumin lowers blood cholesterol, prevents LDL oxidation, anti-platelet control

against myocardial infarction [1]. Curcumin also prevents symptoms associated with type II diabetes, multiple sclerosis and Alzheimer's [2]. Because curcumin has a lot of positive effects on health, nowadays, research on the application of turmeric powder to food products is being studied by scientists around the world. Lim et al. (2011) evaluated the quality and antioxidant capacity of turmeric

powder [3]. Research on the application of turmeric powder on sponge was conducted by Min et al. (2010) [4].

In the world, scientists have researched the addition of other ingredients to wheat flour as a supplement to some cereals to replace wheat flour such as soy [5], buckwheat [6], barley [7], corn embryos [8] .... This study evaluates the effects of turmeric powder added to the quality of dough and bread product for processing bread products meet the nutritional and sensory needs of consumers.

## 2. MATERIALS AND RESEARCH METHOD

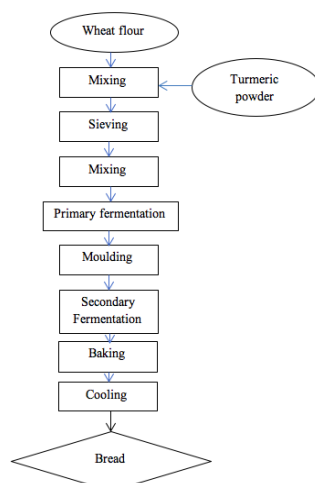
### 2.1. Materials

Wheat flour used in this study was commercially available as Meizan, manufactured by VFM-VILMA wheat milling Co., Ltd, Malaysia.

Turmeric is made from turmeric (*Curcuma longa* L.) harvested in Nghe An. Turmeric was washed, peeled, cut into small pieces and dried at 40°C for 2 days. After drying, the turmeric is puree and sieve through a 150mm hole to form turmeric powder [9]. The moisture content of turmeric powder is  $9.21 \pm 0.01\%$ . Curcumin content in turmeric powder is 23 mg/g. Shiitake flour is added to wheat flour at a rate of 0.5%, 1%, 1.5% and 2% by weight of flour.

### 2.2. Research method

**Process of processing bread with turmeric powder added in the study:**



## 2.3. Method of quality evaluation of dough

### 2.3.1. Determination of wet gluten content

Scale exactly 20gram ( $m_1$ ) dough. Stable for 30 minutes. Pour 1 - 2 liters of water into the pot. Put the flour into, after that soaking and washing the starch. Replace the wash water 3 - 4 times depending on the level of starch in the wash water. Each pour of water must be poured into the sieve to retain gluten. Test the starch in gluten-free water by adding a few drops of  $I_2 / KI$  solution, if the solution is not light blue, the starch is washed out. Add 2-3 drops of gluten to a glass of clear water, and the water is not cloudy. When gluten is washed, squeeze the water out of gluten, squeeze gluten between the palm and dry with a dry towel. The gluten weighed was dried to an accuracy of 0.01 gram. Record the results of  $m_2$  [10].

#### Calculate results:

The wet gluten content is calculated as % by formula:

$$X_1 = \frac{100.m_2}{m_1} \quad (1)$$

### 2.3.2. Determination of dry gluten content

Dry gluten content is the amount of gluten actually formed during kneading. Dry gluten obtained after drying wet gluten. The dry gluten content was determined by wet gluten weighing, placed on the drying plate. Dry 105°C to constant weight. Then weigh and calculate the results [10].

### 2.3.3. Determination of gluten tension

Weigh about 4 gram gluten ( $\pm 0.01$  gram). Then form a sphere and soak in a pot of water at a temperature of 16-20°C for about 15 minutes. Then use two hands to lengthen the gluten block on the millimeter ruler until breaking. The drag time is 10 seconds. When pulling must not twisted gluten rope. Breaking gluten length is defined as gluten tension [10].

## 2.4. Method of quality evaluation of bread

### 2.4.1. Determination of crumb moisture

The moisture content of the gut after baking was determined by drying to constant weight [11]

**2.4.2. Determine specific bread volume after baking**

Before baking, weigh the masses of flour with equal mass and screw in equal volume. After baking, add the bread to the measuring cup. Sift all the sesame seeds off the cake surface. Record the total volume of sesame seeds and bread in the cup (V). Then, pour the sesame seeds into the second cup and read the volume of sesame seeds (V1). The volume of the cake after baking is the volume of sesame seeds replaced. Then weigh the cake and use the ruler to measure the height and diameter of the cake. The specific volume is the ratio of volume and its mass. [10]

**Calculate results**

Specific volume is calculated

$$d = \frac{V_2}{M} \cdot 100 \text{ (cm}^3\text{/g)} \quad (2)$$

M: the remaining weight of the cake after baking (g)

V: total volume of sesame and cake (cm<sup>3</sup>)

V1: volume of sesame (cm<sup>3</sup>)

V2: cake volume after baking (cm<sup>3</sup>) with

$$V_2 = V - V_1$$

**2.4.3. Method of determining the color of the crumb**

The color change of the cake was determined by Chroma meter Minolta CR-400 color meter [12]

**Proceed**

The cake samples are prepared under the same conditions. Freezing frozen -20oC in PE packaging within 48h. Before the measurement, the bread is removed and thawed at room temperature for 15 minutes. Measurement of colonic samples by CR-400 machine

**Result**

**Parameters of device:**

L \* (Lightness) is the brightness of color, L \* the smaller the darker the color.

a (Redness / Greeness) is the color of the sample. If a > 0 and gradually increase, the

darker the red. Conversely a <0 and decreasing, the green color is darker.

b (Yellowness / Blueness) is the color of the sample. If b > 0 and gradually increase, the darker the yellow. Conversely b <0 and decreasing, the darker the blue.

**2.4.3. Analytical method for the nutritional content of bread**

The cake samples are prepared under the same conditions. Freezing frozen -20oC in PE packaging within 48h. Before the measurement, the bread is prepared and thawed at room temperature for 15 minutes. Bread samples will be analyzed for a number of indicators:

Determination of protein content: Quantification of total nitrogen by the Kjeldahl method

Determination of lipid content by Soxhlet method [11].

Determination of curcumin content by HPLC high pressure liquid chromatography.

**2.4.4. Sensory evaluation of bread**

The bread will be rated as a favorite by ranking test [13].

**2.5. Method of processing statistical data**

The experiments were repeated three times. The data collected from the replicate experiments were statistically analyzed using an analysis of variance (ANOVA), standard deviation values, correlation coefficients, and graphs performed on the Software SPSS and Excel 2010.

**3. RESULTS AND DISCUSSION**

**3.1. Effects of turmeric on the dough properties**

**3.1.1. Effect of supplemental turmeric powder on gluten content and gluten content in dough**

*Table 1. Gluten and gluten content in dough samples*

Additional rate	Dry gluten (%)	Wet gluten (%)	Tension (cm)
0%	2.00 ± 0.05 <sup>b</sup>	5.95 ± 0.05 <sup>a</sup>	17.25 ± 0.25 <sup>a</sup>

0.5%	2.13 ± 0.03 <sup>a</sup>	5.98 ± 0.08 <sup>a</sup>	15.50 ± 0.50 <sup>c</sup>
1%	2.05 ± 0.05 <sup>ab</sup>	5.85 ± 0.20 <sup>a</sup>	16.25 ± 0.25 <sup>b</sup>
2%	1.83 ± 0.08 <sup>c</sup>	5.28 ± 0.08 <sup>c</sup>	15.00 ± 0.00 <sup>c</sup>

Results of the study (Table 1) showed that the content of gluten, dry gluten and gluten tension of the turmeric powder added samples tended to decrease. This is explained by the fact that the turmeric ingredients are mainly carbohydrates and fiber. These ingredients prevent the formation of gluten. Ribotta's (2005) study showed that the addition of insoluble fiber and starch content would compete for water absorption with wheat flour [5]. This leads to a lack of water to create a gluten network. Gluten production is not so much and less durable. Thus, the gluten load of the samples decreases with increasing amount of turmeric powder added. However, the difference was only shown in 1.5% dough samples and 2% turmeric powder. Thus, the addition of turmeric powder at the rate of 0.5%, 1% almost no effect on the quality of gluten.

### 3.2. Effects of turmeric on the quality of bread

#### 3.2.1. The influence of turmeric on the volume of bread

**Table 2. Physical Parameters of Turmeric Bread**

Additional rate	Weight (g)	Volume (cm <sup>3</sup> )	Specific volume (cm <sup>3</sup> /g)
0%	32.56 ± 0.41 <sup>b</sup>	137 ± 2.50 <sup>a</sup>	4.23 ± 0.02 <sup>a</sup>
0.5%	33.66 ± 0.59 <sup>a</sup>	135 ± 5.00 <sup>ab</sup>	4.01 ± 0.08 <sup>b</sup>
1%	33.16 ± 0.15 <sup>ab</sup>	130 ± 0.00 <sup>bc</sup>	3.92 ± 0.02 <sup>b</sup>
1.5%	33.57 ± 0.17 <sup>a</sup>	125 ± 5.00 <sup>cd</sup>	3.72 ± 0.13 <sup>c</sup>
2%	33.04 ± 0.06 <sup>ab</sup>	120 ± 0.00 <sup>d</sup>	3.64 ± 0.01 <sup>c</sup>

The results of the study (Table 2) showed that the volume of bread samples was not significantly different at the 5% level. The specific volume of the turmeric bread samples differed significantly at the 5% level with control samples and tended to decrease. Reason of the significant decrease in the specific volume of bread was were explained by the addition of turmeric powder which affected the dough's gluten network. This is explained by the fact that the ingredients in

turmeric are mainly carbohydrates and insoluble fiber. These substances interfere with the formation of gluten and make the gluten network become unstable. [5]

This finding is consistent with Lim (2010) [3].

#### 3.2.2. Effect of added turmeric powder on bread color

Colorimetric results (Table 3) showed that, when added turmeric powder, the values of L, a, and b of bread were significantly different at 5%. The value of L decreases significantly, while values of a and b tend to increase as the amount of turmeric powder increases. Decreased L value means that the brightness of the turmeric powder added samples decreases compared to the control sample. The greater the value of a (<0) and b, the light green and the darker the yellow. Thus, the color of the crumb is affected by the amount of turmeric powder added. The color change of the bread is related to the pigments found in turmeric such as curcuminoids, phenolic compounds formed through oxidative reactions and caramelization during baking. This result is also consistent with Lim (2010) 's study on the addition of turmeric to bread with higher content [3]. Lim (2015) 's research on the addition of turmeric to rice cakes also resulted in a similar tendency for color change of the cake [14].

**Table 3: Results of bread color measurement**

Additional rate	L	a	b
0%	80.87 ± 0.09 <sup>a</sup>	-2.69 ± 0.04 <sup>a</sup>	22.79 ± 0.19 <sup>a</sup>
0.5%	80.80 ± 0.33 <sup>a</sup>	-6.50 ± 0.42 <sup>c</sup>	44.51 ± 0.25 <sup>b</sup>
1%	75.95 ± 0.61 <sup>b</sup>	-4.63 ± 0.09 <sup>b</sup>	45.73 ± 0.06 <sup>c</sup>
1.5%	71.39 ± 0.70 <sup>c</sup>	-3.00 ± 0.07 <sup>a</sup>	45.74 ± 0.70 <sup>c</sup>
2%	71.78 ± 1.22 <sup>c</sup>	-2.82 ± 0.06 <sup>a</sup>	50.95 ± 0.41 <sup>d</sup>

#### 3.2.3. Nutrient content when turmeric powder added to bread

**Table 4: Nutrient content in bread**

Additional rate	Protein (%)	Lipid (%)	Moisture content (%)
0%	7.7 ± 0.99 <sup>a</sup>	10.12 ± 0.07 <sup>a</sup>	43.62 ± 0.42 <sup>ab</sup>
0.5%	7.7 ± 0.99 <sup>a</sup>	10.19 ± 0.01 <sup>a</sup>	43.80 ± 0.15 <sup>a</sup>

1%	7.7 ± 0.99 <sup>a</sup>	10.44 ± 0.01 <sup>b</sup>	43.42 ± 0.20 <sup>b</sup>
1.5%	7.7 ± 0.99 <sup>a</sup>	10.19 ± 0.27 <sup>a</sup>	43.78 ± 0.16 <sup>a</sup>
2%	8.4 ± 0.00 <sup>a</sup>	10.12 ± 0.06 <sup>a</sup>	43.35 ± 0.28 <sup>b</sup>

The results of the study (Table 4) showed no significant differences in the content of bread substitutes in the samples of turmeric powder compared to the control samples (0%). Therefore, when adding turmeric powder to dough, the nutrients do not change significantly.

### 3.2.4. Curcumin content when turmeric added to bread

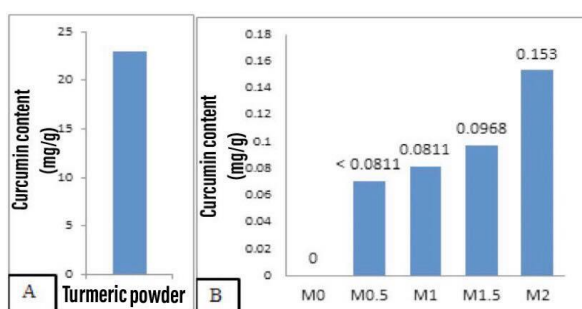


Figure 1 (A) Curcumin content in turmeric powder;

(B) Curcumin content in turmeric biscuits

The results of the HPLC analysis showed that the content of curcumin in bread increased when the content of turmeric powder was added. The highest content of curcumin in bread samples with 2% turmeric powder was 0.153 mg / g. The study of Lim

(2010) with turmeric powder added to curcumin resulted in the addition of 2% turmeric powder at 0.05 mg / g. An additional 2% turmeric powder from Park (2011) has a curcumin content of 0.05 mg/g [9]. Lim (2015) also reports on the amount of curcumin analyzed when adding 2% turmeric powder to the rice cake is 0.08 mg / g [14]. Thus, the content of curcumin in the bread samples in this study is higher than the study of other authors when adding turmeric powder to the cake.

### 3.3. The effect of turmeric powder added to the taste of bread

Sensory evaluation results showed that the 1% turmeric powder form was preferred. 1% yellow turmeric powder is highly appreciated, it has the aroma and taste of turmeric but not lose the taste of bread.

## 4. CONCLUSION

The results showed that samples containing powdered turmeric powder tended to change in dough properties but with a 1% addition, the change was negligible. Curcumin, a highly bioavailable substance, has been found in turmeric bread. The presence of curcumin in bread shows that the bread's use value is enhanced; at the same time, it creates a beautiful yellow color for the crumb.

## REFERENCES

- [1] Ajaikumar B., Kunnumakkara Preetha Anand., Robert A. Newman., Bharat B. Aggarwal. *Bioavailability of curcumin, problems and promises*. Molecular Pharmaceutics, vol.4 (2007).
- [2] Ishita Chattopadhyay, Kaushik Biswas, Uday Bandyopadhyay and Ranajit K. Banerjee. *Turmeric and curcumin: Biological actions and medicinal applications*. Current Science), vol. 87 (2007).
- [3] H.S. Lim. *Quality and antioxidant properties of bread containing turmeric (Curcuma longa L.) cultivated in South Korea*. Food Chemistry 124 (2011). 1577–1582.
- [4] Min Ja Seo, Jung Eun Park, and Myung Sook Jang. *Optimization of Sponge Cake Added with Turmeric (Curcuma longa L.) Powder Using Mixture Design*. Food Science. Biotechnol. 19(3) (2010): 617-625
- [5] Pablo D Ribotta. *Effect of soybean addition on the rheological properties and breadmaking quality of wheat flour*. Journal Science Food Agriculture (2005): 0022–5142.
- [6] Lin, L. Y., Liu, H. M., Yu, Y. W., Lin, S. D., & Mau, J. L.. *Quality and antioxidant property of buckwheat enhance bread*. Food Chemistry (2009), 987–991.

- [7] Holtekjlen, A. K., Bævre, A. B., RØdbotten, M., Berg, H., & Knutsen, S. H. *Antioxidant properties and sensory profiles of breads containing barley flour*. Food Chemistry (2008), 414–421.
- [8] M., Nasir, M., Ravi, R., Butt, M. S., Dolan, K. D., & Harte, J. B. *Effect of defatted maize germflour addition on the physical and sensory quality of wheatbread*. LWT – Food Science and Technology, 42 (2009), 464–470.
- [9] S.H. Park. *Evaluation of antioxidant, rheological, physical and sensorial properties of wheat flour dough and cake containing turmeric powder*. Food Science and Technology International (2011), 18.
- [10] Nguyen Van Dat, Ngo Van Tam. *Food Cereal Analysis*. Ha Noi Publishing House (1975), 348.
- [11] S. Suzanne Nielsen. *Food Analysis Fourth Edition*. Springer,(2009), 85.
- [12] Nga Anh Tuan. *Color - Theory and Applications*. National University Publishing House. (2010).
- [13] Jian Bi. *Sensory Discrimination Tests and Measurements*. Blackwell Publishing,(2006), 82 – 92
- [14] Seung-Taik Lim. *Improvement in antioxidant functionality and shelf life of yukwa (fried rice snack) by turmeric (Curcuma longa L.) powder addition*. Food Chemistry 199 (2015) 590 – 596.

**Corresponding author:**

Nguyen Dang My Duyen, MSc

Faculty of Chemical and Food Technology, HCMC University of Technology and Education

Email: myduyen@hcmute.edu.vn