PREPARATION OF INSTANT COUSCOUS MADE FROM EGYPTIAN DURUM WHEAT FLOUR FORTIFIED WITH INACTIVE DRIED YEAST AND SKIMMED MILK POWDER

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(Manuscript received 22 January 2017)

Abstract

The objective of this study was to produce an instant couscous product with skimmed milk powder and partial substitution (5, 10, 15 and 20%) of durum wheat flour by inactive dried yeast. In this study, chemical, physical, nutritional and sensory properties of couscous samples were determined. Inactive dried yeast and skimmed milk powder contained a higher percentage of protein, lipids and ash than durum wheat flour. The results indicated that addition of inactive dried yeast and skimmed milk powder to durum wheat flour lead to increase in protein, lipids and ash contents in the couscous, as well as, addition of inactive dried yeast lead to increase in mineral, amino acid and B vitamins (Thiamin, Riboflavin, Nicotinic, B6, Folic and B12) contents in the end product. Cooking properties of couscous were affected negatively by the increasing levels of inactive dried yeast in the formulation. Regarding to the sensory evaluation of couscous, the result showed that, couscous made from durum wheat flour fortified by 5% inactive dried yeast and 5% skimmed milk powder recorded higher acceptability compared to control sample. This study showed that, addition inactive dried yeast up to 5% and 5% skimmed milk powder produced instant couscous with high nutritional value and good sensory properties.

Key words: durum wheat flour, quick preparation couscous, inactive dried yeast, skimmed milk powder.

INTRODUCTION

Durum wheat grain (Triticum durum Desf.) is traditionally used for the production of pasta، couscous and several other products (Abecassis *et al.*, 2012). Durum wheat is a minor crop, grown on only 8 to 10% of all the wheat cultivated area. The remaining area is cultivated with hexaploid bread wheat. Durum wheat is better adapted to semiarid climates than is bread wheat. The world's durum wheat acreage and production is concentrated in the Middle East, North Africa, the former USSR, the North American Great Plains, India, and Mediterranean Europe (International Wheat Council, 1991). Durum is a spring wheat, although winter durum is grown. In spite of its low acreage, durum wheat is an economically important crop because of its unique characteristics and end products. It is generally considered the hardest wheat kernel. Durum kernels are usually large, golden amber, and translucent. Several studies have been made on the improvement of the properties and nutritional value of durum wheat products by several additives (Demir *et al.*, 2015).

Couscous, a paste product made from what flour, is considered one of the major food staples in North African countries, such as Egypt, Libya, Tunisia, Algeria, and Morocco (Kaup and Walker, 1986). An estimated 10% of durum wheat in the Near East is used to manufacture couscous. Couscous is closely related to pasta, as durum wheat, the same type of wheat that is most commonly used for making pasta, ground into semolina flour (Coskun, 2013).While couscous is usually made from durum wheat semolina in North African countries, it is also made from bread wheat, sorghum, pearl millet, or maize in other regions of the world. Sticky cooked couscous is extremely undesirable. Stickiness has been positively correlated with starch damage and long rehydration time for weak gluten cultivars. Traditionally, couscous is handmade in small quantities in the home by mixing a small quantity of water with semolina in a large bowl. The moisture content of the hydrated semolina is ~30%. The hydrated semolina is rubbed between the hands until small granules are formed. These granules are screened through sieves to obtain a uniform size. Granule size uniformity is very important for good cooking quality. Hydration rate during cooking will be slower with larger couscous granules. The granules are precooked, air dried, and stored. Commercially, couscous can be produced continuously at 500 kg h-1. The steps required to make commercial couscous are the same as traditional couscous. Manufacturing couscous requires eight steps: 1) Blending: Semolina is mixed with water or a salt water; 2) Agglomeration: Semolina particles are combined into a mixture; 3) Shaping: The particulate mixture is reduced and shaped; 4) Steaming: The resulting granulate is precooked; 5) Drying: The coarse agglomerates are dried; 6) Cooling: The products are cooled to ambient temperature; 7) Grading: The couscous is separated into fine (0.8 to 1.2 mm), medium, and coarse (1.5 to 2.5 mm) granules; and 8) Storage: The couscous is stored until packaged. Demir, 2015 reported couscous to contain only 100–120 calories per half-cup serving, and includes complex carbohydrates, vitamin B and minerals)

Inactive yeast powder consists of pure, inactivated yeast of S.cerevisiae (Auxoferm) or Torula sp. (Provesta). Due to the favourable natural composition of its yeast protein, with all essential amino acids, air inactive yeast powder forms a valuable supplement to daily nutrition. Furthermore, the product stands out for its content of minerals and trace elements and has a typical yeast flavor. Giselle *et al,.* (2 0 11). (Asael *et al,(*2014)*.* The Auxoferm and Provesta yeast powders have a high water binding and emulsifying capacity. It is perfectly suitable for compression. It is used as both, a food supplement and human food ingredient. Some typical applications include snacks, pizzas, peanuts and many other foods where a typical yeast flavor is wanted. Special vitamin yeast powder consists of a pure, inactivated yeast (S.cerevisiae), the nutritional value of which is increased by a supplement of the vitamins niacin, vitamin B1, vitamin B2 and vitamin B6 (Dubey *et al.,* 2010). The products show a favourable composition of the yeast protein with all essential amino acids and it is distinguished through its content of minerals and trace elements. The product has a pleasant, yeast-typical taste. Auxoferm special vitamin yeast powder has a good water binding and emulsifying capacity. It is excellent for compression.

The aim of this work is to produce instant couscous, which has better nutritional value and easily prepared.

MATERIALS AND METHODS

Materials:

The Egyptian wheat durum (Bany-sowaf-1), was obtained from Field Crops Research Institute, Agricultural Research Center. The Egyptian wheat durum flour used in couscous preparation had 12.51% moisture and 13.17% crude protein content. Foreign materials and broken kernels were removed by using 7 mm sieves. Wheat durum grains were washed and tempered up to 20% moisture level with distilled water for 12 h at room temperature. After tempering, the wheat grains were milled in a lab hummer mill. Wheat durum flour was sieved by sieving checker under sieves (No. 355 μm .Mesh No.40). It gives 82.5% wheat durum flour extraction,

Inactive dried yeast was purchased from the Egyptian & Belgium company for yeast production (Egybelgium). 10th Ramadan City – Egypt. Inactive dried yeast with 6.71% moisture and 51. 2% crude protein content.

The skimmed milk powder obtained from local market- Egypt. Skimmed milk powder used had 6.81% moisture and 35.5% protein.

Couscous Preparation

Couscous blends were prepared by formulations which record in **Table -1**.

Table 1. Formulations of Couscous samples.

	control	1	2	3	4
Egyptian durum flour 82.5%.	**100**	**95**	**90**	**85**	**80**
Inactive dried yeast(%)	**_**	**5**	**10**	**15**	**20**
Skimmed milk powder (g/100gm)	**_**	**5**	**5**	**5**	**5**
Vanillin powder(%)	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**

Couscous is produced in the same way as couscous products industrially. Traditional couscous is made by mixing of Egyptian durum flour 82.5% extraction with inactive dried yeast (by different blends) and Skimmed milk powder.5 g/100gm, dough giving the couscous granule a spherical shape.

Couscous samples were prepared according to a traditional method given by Çelik *et al.* (2004). For control couscous preparation, durum wheat flour and milk were used. In couscous samples, durum wheat flour used for coating dough is replaced with inactive dried yeast at a ratio of 0, 5, 10, 15 and 20% (w/w). The inactive dried yeast addition ratios were determined with preliminary experiments. For couscous preparation, flour was placed in a large bowl and wetted with milk. Then, the mixture was rolled by rubbing with the hand while flour was being added. Thus, the surfaces of the couscous granules were covered and coated by the dough. These wetting and rolling processes were continued until the size of couscous particles had reached a diameter of 3–5 mm. Then, the couscous was dried on a flat plate for 12 hours in oven at (60^{o} C) to decrease the moisture content below 10% (Çelik *et al.* 2004). Dried samples were kept in closed polyethylene bags at room temperature until used.

Cooking Properties

For evaluation of cooking properties, weight increase (WI), volume increase (VI) and cooking loss (CL) analysis was made on the couscous samples. For WI and VI determination, 10 g couscous sample was boiled for 18 min in 300 mL distilled water. After cooking, the samples were washed with distilled water and drained for 2 min. WI and VI were determined in drained couscous. Drained cooking water was dried to constant weight and CL was calculated. WI was calculated by differences of dry (before cooking) and cooked (after draining) couscous weights. For VI measurement, raw and cooked couscous was poured into a 250-mL graduated glass cylinder with 150 mL of distilled water. The increase in the water level for raw and cooked couscous was measured and VI% was calculated as shown in the following equation:

WI (%) = 100× (weight of cooked couscous - weight of raw couscous)/ weight of raw couscous

VI (%) = 100× (volume of cooked couscous - volume of raw couscous)/ volume of raw couscous

CL (%) = 100× (weight of residue in cooking water)/ (weight of raw couscous)

Bulk Density: Was determined by filling a 500- ml graduated as cylinder 250g of couscous. Measurements were expressed as the ratio of couscous weight per unit volume. Debbouz and Donnelly, (1996).

<u>Color Evaluation:</u> Color was of the dry couscous samples before cooking was evaluated by measuring according to the standard method of **(AACC, 2000)**, L- (100 = white; 0 = black), A- (red - green) and B- (yellow - blue) values using a Hunter Lab Color. Values are the mean of three determinations.

Proximate Analysis:-

Proximate compositions of all the flours used in the couscous preparation were evaluated using standard methods. Moisture, protein, lipids, ash and crude fibers content were estimated according to AACC (2000). Total digestible carbohydrates (TDC) were calculated by difference. TDC=100-(Protein+ fat+ Crude.

Determination of Amino acid Profile of Couscous

Amino acid content was determined using amino acid analyzer Biochrom 30 using the instruction manual according to AOAC (2005).

Biological value of couscous

Biological value of the couscous were calculated according to Eggam *el .al,* (1979) as follows:

Biological value%= 39.55+8.89 x lysine (g/100g protein)

Chemical score of couscous

Chemical score were calculated according to **FAO/WHO(2007)** as follows:

$$\textbf{Chemical score\%} = \frac{\text{Essential amino acid of crude protein}}{\text{Essential amino acid of FAO/WHO}} \times 100$$

Sensory Evaluation

Couscous samples were evaluated by 10 panelists, who are familiar with the characteristics of couscous from bread and pasta researches department Food Technology Research Institute. The panelists were asked to score the couscous in terms of flavor, appearance, firmness, stickiness and overall acceptability using a 5-point scale where 1 represented "dislike extremely," 3 represented "acceptable" and 5 represented "like extremely" in a particular attribute as described by Demir *et al.,* (2015).

Statistical analysis:

The obtained data from sensory evaluations were statistically analyzed by the least significant differences value (L.S.D) at 0.05 levels probability procedure to Snedecor and Cochran (1997).

RESULTS AND DISCUSSION

Proximate Composition of Raw Materials and Couscous Samples Blends:-

Table 2 shows the proximate chemical composition of durum wheat flour (DWF), inactive dried yeast (ICDY) and skimmed milk powder (SMP). Ash, protein, crude fiber, fats and total carbohydrates. Results are in agreement with those reported by Elgun and Ertugay. (1995) for durum wheat flour, while Encan *et al*. (2005) showed lower protein and ash contents in his study. But durum wheat flour had higher content of crude fiber and total carbohydrates. However, inactive dried yeast (ICDY) and skimmed milk powder were higher in ash and protein contents.

Table 2. Proximate composition of raw materials and couscous samples made from Egyptian durum and inactive dried yeast.

	Protein %	**Crude %fiber**	**Ash %**	**Fat %**	**Total carbohydrate %**
Egyptian durum wheat	13.17±0.02	0.84±0.05	0.80±0.01	0.82±0.00	84.37±0.45
Inactive dried yeast	51.2±0.10	0.51±0.00	11.35±0.07	1.1±0.0٠	35.84±0.34
Skimmed milk powder	35.5±0.20	---	8.19±0.51	0.81±0.0١	55.4±0.32
control	13.00±0.03	0.81±0.02	0.80±0.01	0.80±0.0٦	84.59±0.65
1	17.46±0.15	0.80±0.01	1.76±0.01	0.92±0.0٧	79.06±0. 12
2	19.54±0.11	0.71±0.01	2.33±0.01	0.96±0.05	76.46±0. 22
3	20.80±0.08	0.66±0.00	2.88±0.05	1.05±0.03	74.60±0. 39
4	22.60±0.05	0.59±0.03	3.41±0.15	1.11±0.10	72.29±0.02

*Chemical compositions are dry weight basis

*Total carbohydrates (TC) were calculated by difference. DC=100-(Protein+ fat+ Crude fibers+ ash) on dry weight * * Results are dry weight basis.

Protein, values in couscous samples were (17.46-22.60%) compared to (13.00 %) in control sample. Ash values were (1.76-3.41%) and (0.80 %) in control sample. Fat values were (0.92-1.11%) and (0.80 %) in control sample %, while crude fiber and total carbohydrates decreased with increasing levels of fortification. Also, **Table 2** shows that couscous samples were higher in all nutrition parameters compared with control sample. This may be due to fortification of couscous samples with inactive dried yeast and skimmed milk powder which is rich in nutrients.

In (Table 3) the average bulk density was found to be (0.712 g/cm3) for control which was comparable to those reported by El Yamlahi *et al* .(2014) who found the bulk density to be (0.62g/cm3) for semolina and (0.60 g/cm3) for couscous.

Table 3. Physical and cooking properties of couscous samples made from Egyptian durum and inactive dried yeast.

Couscous Samples	Moisture (%)	Bulk density(g/ cm3)	Weight increase (%)	Volume increase (%)	Cooking loss (%)
Control	**9.6a ±0.26**	**0.712a ±0.000**	**165a ±2.12**	**158a ±2.95**	**5.70c ±0.07**
1	**9.4a ±0.34**	**0.655b ±0.003**	**163a ±2.33**	**155a ±1.12**	**5.92c ±0.17**
2	**9.5a ±0.02**	**0.633b ±0.001**	**158ab ±1.55**	**151b ±1.42**	**6.25b ±0.12**
3	**9.3a ±0.00**	**0.600bc ±0.021**	**153b ±2.00**	**147c ±1.82**	**6.40ab ±0.15**
4	**9.1a ±0.22**	**0.561c ±0.014**	**147d ±0.90**	**143d ±2.78**	**6.58a ±0.14**

Also, the bulk density decreased with increasing addition of inactive dried yeast from 0.655 g/cm^3 (for 5% inactive dried yeast) to 0.561 g/cm^3 (for 20% inactive dried yeast). The observed decrease in bulk density between couscous samples is due to cooking in vapor and boiling water which caused dissolution of the constituents, particularly starch as reported by El Yamlahi *et al* 2014.

Cooking properties and color values of the couscous samples indicates the technological properties of couscous are given in **Tables 3 and 4**. In the present study, weight increase values of couscous samples containing 5, 10, 15 and 20% inactive dried yeast and 5% skimmed milk powder decreased to 163, 158, 153 and 147% respectively, compared with 165% for control. The percent decrease in weight, may be due to the protein type in durum which had high water absorption, also, decrease in starch contain with the increasing of substitution and the possible decrease in water intake for the gelatinization as explained by Demir *et al* 2015. Also, Al-Shehry 2016 who reported that, percent weight increase values decreased significantly ($P < 0.05$) with increase of high protein substitution level. While, Sabanis *et al.* (2006) found that weight increase values of lasagna decrease proportionally as the amount of high protein flour in lasagna formulation increased.

As the inactive dried yeast level increased in couscous formulation, volume increase values were decreased significantly. Sabanis *et al.* 2006 reported the decrease in volume increase of couscous could be dependent on the starch contents. As the percentage of inactive dried yeast increased, starch content of the samples decreased and this low starch content contributed to low volume increase. In the same manner, inactive dried yeast addition into couscous formulation resulted in significant increase in cooking loss (Table 3) when compared with the control sample.

This increase may be because of decrease in the gelatinizable starch content in the formulation (Sabanis *et al.* 2006). Also, Demir *et al*. 2015 reported that, the vital gluten addition decreased cooking loss significantly when compared with the other literature findings on pasta, noodle and couscous applications.

Table 4. COLOR VALUES OF COUSCOUS SAMPLES

	L	A	B
Wheat durum flour	**91.66b ±0.65**	**0.84e ±0.02**	**8.55e ±0.90**
Inactive dried yeast	**84.48e ±1.24**	**1.54bc ±0.06**	**17.22a ±1.90**
Skimmed milk powder	**97.34a ±0.77**	**0.78e ±0.00**	**8.11e ±0.60**
Control	**89.44c ±0.05**	**1.04d ±0.14**	**11.65d ±0.89**
1	**88.86c ±0.81**	**1.45c ±0.17**	**12.42cd ±0.95**
2	**88.25cd ±1.15**	**1.62bc ±0.09**	**13.10c ±1.05**
3	**87.62cd ±1.65**	**1.88b ±0.65**	**13.88bc ±0.15**
4	**86.94d ±0.31**	**2.24a ±0.65**	**14.56b ±0.85**

Duncan’s multiple range test. Means with same letter within column are

Color of couscous is an important quality parameter for consumer acceptability. A bright yellow creamy color is preferred commonly. Color values of dry couscous samples are presented in Table 4. Inactive dried yeast addition level was found significant ($P < 0.05$) for lightness (L), yellowness (b) and redness (a) values of the couscous samples. When compared with the control sample, the lightness value of the couscous containing 5–20% inactive dried yeast decreased, but the yellowness of same samples increased. This result is in the same line with Demir *et al.*, 2015, they found that increases in darkness and yellowness of end product (couscous) were caused by the raw material color intensity. The high natural color intensity of raw material and the increasing of millard reaction risk due to increasing nitrogenous compounds in formulation are the probable causes of the color changes. Also, Çelik *et al.* (2004) reported that usage of the soy flour as a source of protein in couscous preparation decreased lightness value.

Table 5. Macro-and micro-elements contents of couscous samples made from Egyptian durum and inactive dried yeast (mg/ 100g couscous).

Sample	Selenium (Se)	Potassium (K)	Sodium (Na)	Calcium (Ca)	Zinc (Zn)	Iron (Fe)	Copper (Cu)	Magnesium (Mg)
Control	84.9e ±1.06	112.11e ±5.65	27.44e ±0.32	55.20e ±0.77	0.91c ±0.45	1.77d ±0.05	0.26a ±0.04	37.90d ±1.05
1	167.4d ±2.87	158.54d ±9.15	100.25d ±1.00	145.66d ±8.89	1.15c ±0.12	2.35c ±0.20	0.23a ±0.01	42.23c ±0.75
2	242.8c ±4.40	177.85c ±6.64	144.11c ±1.05	186.15c ±3.95	1.58b ±0.02	2.80b ±0.10	0.195a ±0.00	45.89b ±1.50
3	317.4b ±4.55	196.92b ±4.12	186.6b ±0.65	231.32b ±4.05	2.00b ±0.01	3.24ab ±0.15	0.175a ±0.00	48.22b ±2.61
4	392.7a ±2.33	219.55a ±1.46	228.31a ±5.21	278.25a ±2.65	2.58a ±0.02	3.61a ±0.12	0.160a ±0.00	51.11a ±1.00

Macro-and micro-elements contents of the couscous samples are given in **Table 5**. Data showed that major minerals (K, Ca, Na and Mg) and minor elements (Se, Cu, Fe and Zn) were detected in treatments 1, 2, 3 and 4 at higher levels than that observed in DWF. All of the investigated minerals in couscous samples increased with ICDY and SKP addition. According to the control sample, Se, K, Na, Ca, Zn, Fe, Cu and Mg contents (mg/100 g) increased from 84.90, 112.11, 27.44, 55.20, 0.91, 1.77, 0.26 and 37.90 mg/100g for control sample to 392.70, 219.55, 228.31, 278.25, 2.58, 3.61 ,0.160 and 51.11 mg/100g in couscous sample containing 20% ICDY 5%, SKP, respectively. Çelik *et al.* (2004) reported that K, Ca and Fe values of couscous as 165.62 mg/100g, 48.30 mg/100g and 2.73 mg/100 g, respectively. The increase in minerals with added inactive dried yeast was agreement with Bekatorou *et al.*, 2006. They found that, yeast is an excellent source of Ca, P, K, Mg, Cu, Fe, Zn, Mn and Cr and has been studied extensively for its medical properties. The increase in mineral content is mainly due to ash content provided by the added ingredients such as ICDY and SKP. In the same line, (Crawshaw, 2004) fount that the, inactivated yeast are highly values source of protein, mineral. Giselle *et al,.* (2011).

Table 6. Sensory properties of couscous samples

Couscous Samples	Appearance	Flavor	Color	Chew	Mouth feeling	Stickiness	Overall acceptability
Control	4.60a ±0.22	4.40a ±0.00	3.32a ±0.11	3.21a ±0.20	3.57a ±0.09	3.46a ±0.22	22.56a ±0.80
1	4.57a ±0.44	4.55a ±0.08	3.32a ±0.19	3.30a ±0.14	3.54a ±0.12	3.49a ±0.23	22.78a ±0.91
2	4.28b ±0.21	3.35c ±0.32	3.25a ±0.14	3.10ab ±0.15	3.47a ±0.17	3.44a ±0.05	21.87b ±1.91
3	3.95b ±0.20	3.96b ±0.33	2.81b ±0.25	2.75b ±0.08	2.85b ±0.19	2.91b ±0.05	19.25c ±1.00
4	3.25c ±0.02	2.54d ±0.28	2.36c ±0.21	2.14c ±0.10	2.62c ±0.20	2.47c ±0.03	15.38d ±0.65

Sensory scores of couscous samples are summarized in **Table 6**. Data in **Table (6)** represent the mean scores for appearance, flavor, color, chew, mouth feeling, stickiness and overall acceptability for prepared couscous fortified with inactive dried yeast at different levels. The highest values for flavor, color, chew, stickiness and overall acceptability were observed in couscous with 5% inactive dried yeast. But for appearance and mouth feeling the highest value was recorded by control sample. This improvement in couscous with 5% inactive dried yeast due to the addition of inactive dry yeast and skim milk. These ingredients could improve the sensory characteristics of couscous. There was no significant difference between control and samples with 5 regarding all sensory characteristics expect appearance for 5% replacement. The sensory evaluation of the samples that contain 10, 15 and 20% inactive dried yeast were not liked by the panelists when compared to other samples. Also, the sample that contain 10% replacement was had acceptable characteristics ,but low value compared with control and 5% replacement.

Amino acid score is very important to evaluate the content of essential amino acids in foods and also to cover the nutritional requirements of protein. Amino acids composition of couscous made from Egyptian durum wheat flour and different forms of inactive dried yeast are presented in Table (7). In this present study, essential amino acids (***EAA***) and non-essential amino acids were higher in couscous made from mixture durum wheat flour and different levels (5, 10, 15 and 20 %) of inactive dried yeast than that detected in couscous made from durum wheat flour as control. This increase is due to the high percentage of protein and amino acids in the inactive dried yeast and skim milk powder. The results of 15 and 20 % inactive dried yeast (3 and 4 samples) were near to the recommended by FAO/WHO. From the same table showed that the limiting amino acids were lysine for control and methionine for couscous samples made from mixture durum wheat flour and inactive dried yeast. On the other hand the biological value increased in couscous samples (1, 2,3 and 4) than control (73.15, 76.88 , 80.53 and 82.75) respectively, compared with (59.73) control. These results are in agreement with those of Yalcin *et al.*, (2008), dried yeast contained lysine (0.31%), threonine (0.19%), arginine (0.56%), methionine (0.1%).Also, Yalcin *et al.*, (2008) mentioned that, The amino acid analysis of dried yeast indicates that yeast should be a source of good-quality protein. From table (7), the essential and non-essential amino acids were high in couscous samples which supplemented with inactive dried yeast, especially lysine which is the first limiting amino acid in cereal flours.

B vitamins contents of couscous samples made from Egyptian durum and inactive dried yeast showed in table (8). The results indicated that, as the level of inactive dried yeast replacement increased, values of vitamins content in couscous samples increased. The increase in Thiamin, Riboflavin, Nicotinic, B6, Folic and B12 vitamins were from1.82, 2.83, 15.94, 0.60, 1.66 and 0.81for control couscous to5.328, 7.21, 30.85, 5.21, 17.98 and 6.66 for couscous replaced by 20% inactive dried yeast. Our present findings are in line with Asael *et al,* (2014) who stated that inactive dried yeast was higher in B vitamins.

Table 7. Amino acid contents of couscous samples made from Egyptian durum and inactive dried yeast %.

	Control			1			2			3			4			
EAA	Amino acid 100sample/g	Amino acid 100protein/g	Chemical score%	Amino acid 100sample/g	Amino acid 100protein/g	Chemical score%	Amino acid 100sample/g	Amino acid 100protein/g	Chemical score%	Amino acid 100sample/g	Amino acid 100protein/g	Chemical score%	Amino acid 100sample/g	Amino acid 100protein/g	Chemical score%	*FAO//WHO (2007)
Leucine	**0.75**	**5.68**	**86.06**	**1.01**	**5.78**	**87.57**	**1.10**	**5.86**	**88.78**	**1.19**	**5.95**	**90.15**	**1.28**	**6.08**	**92.12**	**6.6**
Valine	**0.51**	**3.86**	**110.28**	**0.76**	**4.29**	**122.57**	**0.84**	**4.35**	**124.28**	**0.91**	**4.44**	**126.28**	**0.99**	**4.51**	**128.85**	**3.5**
Lysine	**0.30**	**2.27**	**39.14**	**0.66**	**3.78**	**65.17**	**0.86**	**4.20**	**72.41**	**0.93**	**4.61**	**79.48**	**1.02**	**4.86**	**83.79**	**5.8**
Isoleucine	**0.39**	**2.95**	**105.35**	**0.56**	**3.20**	**114.28**	**0.67**	**3.42**	**122.14**	**0.77**	**3.70**	**132.14**	**0.86**	**3.80**	**135.71**	**2.8**
Phenylalanine	**0.42**	**3.17**	**50.31**	**0.66**	**3.78**	**60.00**	**0.78**	**3.99**	**63.33**	**0.87**	**4.18**	**66.35**	**0.98**	**4.34**	**68.89**	**6.3**
Threonine	**0.27**	**2.04**	**60.00**	**0.42**	**2.41**	**70.88**	**0.57**	**2.91**	**85.59**	**0.70**	**3.37**	**99.11**	**0.81**	**3.58**	**105.29**	**3.4**
Methionine	**0.13**	**0.98**	**39.20**	**0.23**	**1.22**	**48.80**	**0.25**	**1.32**	**52.80**	**0.27**	**1.40**	**56.00**	**0.29**	**1.53**	**61.20**	**2.5**
Total E.A.A	**2.77**	**20.95**	**490.34**	**4.3**	**24.46**	**569.27**	**5.07**	**26.05**	**609.33**	**5.64**	**27.65**	**649.51**	**6.23**	**28.70**	**675.85**	**30.9**
Non-E.A.A																
Histidine	**0.32**	**2.42**		**0.42**	**2.40**		**0.46**	**2.35**		**0.51**	**2.45**		**0.57**	**2.52**		
Arginine	**0.49**	**3.71**		**0.65**	**3.72**		**0.72**	**3.68**		**0.77**	**3.70**		**0.84**	**3.72**		
Serine	**0.36**	**2.73**		**0.51**	**2.92**		**0.63**	**3.22**		**0.76**	**3.65**		**0.89**	**3.94**		
Tyrosine	**0.25**	**1.89**		**0.43**	**2.46**		**0.58**	**2.97**		**0.71**	**3.41**		**0.85**	**3.76**		
Aspartic	**0.50**	**3.79**		**0.90**	**5.15**		**1.13**	**5.78**		**1.21**	**5.81**		**1.29**	**5.71**		
Glutamic	**2.88**	**21.80**		**3.27**	**18.72**		**3.66**	**18.73**		**4.07**	**19.57**		**4.45**	**19.69**		
Proline	**0.90**	**6.81**		**1.06**	**6.07**		**1.12**	**5.73**		**1.19**	**5.72**		**1.26**	**5.57**		
Glycine	**0.39**	**2.95**		**0.48**	**2.75**		**0.58**	**2.97**		**0.66**	**3.17**		**0.75**	**3.31**		
Alanine	**0.39**	**2.95**		**0.61**	**3.49**		**0.71**	**3.63**		**0.77**	**3.70**		**0.84**	**3.72**		
Cysteine	**0.20**	**1.51**		**0.24**	**1.37**		**0.26**	**1.33**		**0.28**	**1.35**		**0.31**	**1.37**		
Total NonE.A.A	**6.68**	**47.6**		**8.57**	**49.05**		**9.85**	**50.39**		**10.93**	**52.53**		**12.05**	**53.31**		
Limiting Amino acid			**Lysine**			**Methionine**			**Methionine**			**Methionine**			**Methionine**	
Biological value			**59.73**	**73.15**				**76.88**		**80.53**				**82.75**		

Table 8. The B complexes vitamins contents of couscous samples made from Egyptian durum and inactive dried yeast (mg/ 100g couscous).

Couscous samples	Thiamin mg	Riboflavin mg	Nicotinic	B6 mg	Folic	B12 mg
Control	1.82e ±0.06	2.83e ±0.13	15.94d ±0.92	0.60c ±0.06	1.66d ±0.39	0.81e ±0.00
1	3.53d ±0.30	5.62d ±0.19	23.20c ±1.17	2.71b ±0.19	11.6c ±0.98	2.83d ±0.06
2	4.155c ±0.45	5.91c ±0.20	25.95b ±0.99	3.89b ±0.28	13.92b ±0.99	4.00c ±0.19
3	4.75b ±0.16	6.57b ±0.23	28.11ab ±2.90	4.68ab ±0.19	15.64b ±0.91	5.64b ±0.23
4	5.32a ±0.47	7.21a ±0.48	30.85a ±1.90	5.21±a 0.46	17.98a ±0.28	6.66a ±0.19

CONCLUSION

Fortification of couscous formulation with 5% skimmed milk powder and inactive dried yeast at different ratios (5, 10, 15 and 20%) improved the nutritional values in terms of ash, protein, mineral, amino acid and vitamins. In contrast, addition of inactive dried yeast decreased the cooking quality of the product and resulted in samples with lower volume increase and higher cooking loss. The overall acceptability scores of couscous samples with ICDY and SKP up to 5% addition level was found to be acceptable. Couscous made from 95% WDF, 5% ICDY and 5% SMP recorded higher result in the sensory evaluation compared to the control. Overall Addition of ICDY to level 5and 10% and SMP have improved the nutritional couscous product, while Addition of ICDY to level 5% give the best values , in technological and sensory qualities of couscous product, compared with control.

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اعداد الكسكس سريع التجهيز المصنع من دقيق قمح الديورم المصري والمدعم بالخميرة الغير نشطة ومسحوق الحليب الفرز

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تهدف هذه الدراسة هو إنتاج الكسكس سريع التجهيز مع مسحوق الحليب منزوع الدسم باستبدال جزئي (٥، ١٠، ١٥ و٢٠٪) من دقيق القمح الديورم بالخميرة المجففة غير النشطة.

في هذه الدراسة، تم تقيم الصفات الكيميائية، الخواص الفيزيائية الغذائية والحسية لعينات الكسكس. الخميرة المجففة غير النشطة ومسحوق الحليب منزوع الدسم الذي يحتوي على نسبة عالية من البروتين، والدهون والرماد مقارنة بدقيق القمح الديورم. أشارت النتائج أن إضافة الخميرة المجففة غير النشطة ومسحوق الحليب منزوع الدسم الى دقيق القمح الديورم تؤدي إلى زيادة في نسبة البروتين والدهون والرماد في الكسكس، وكذلك، إضافة الخميرة المجففة الغير نشطة تؤدي إلى زيادة في محتوى المعادن، والأحماض الأمينية ومجموعة فيتامين بي المركبة في المنتج النهائي. وتأثرت خصائص الطهي الكسكس سلبا على مستويات متزايدة من اضافة الخميرة المجففة غير النشطة. بينما التقييم الحسي أظهرت النتيجة أن الكسكس المصنوع من دقيق القمح الديورم المضاف الية ٥٪ الخميرة المجففة الغير نشطة ٥٪ مسحوق الحليب منزوع الدسم سجلت قبول أعلى مقارنة بالعينة الكونترول. وأظهرت هذه الدراسة أن اضافةالخميرة الغير نشطة بنسبة ٥٪ و٥٪ مسحوق اللبن منزوع الدسم لا إنتاج الكسكس سريعة التجهيز ذات قيمة غذائية عالية والخصائص الحسية جيد.