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STUDIES ON FLOUR COMPOSITE AND ITS EFFECT ON BALADY BREAD MAKING

Sanaa A. M. S. El-Sherief
Food Science Dept. Fac. of Agric., El-Minia Univ.
El-Minia. Egypt.

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ABSTRACT

Wheat composite flours from some cereals were used in processing ten formulas beside the control (wheat flour ٨٢٪ extraction) which it used in preparing supplemented balady breads. Blends were consisting from control, five levels for each substitute of barley and sorghum as ١٥, ٢٠, ٢٥, ٣٠ and ٣٥٪.

Some studies were done to evaluate the nutritional, rheological and sensory properties of the raw materials and the breads from wheat and wheat composite flours (eleven samples). Chemical results of raw materials showed that the barley flour has the highest contents of ash, protein and fat, followed by sorghum flour but it has lower content of protein compared with wheat flour. Also it showed the highest level of carbohydrate followed by barley flour and the lowest content was recorded in wheat flour.

The supplementation with composite flours (barley flour) increased the levels of protein, fat and ash in breads, while the levels of carbohydrate and calories were decreased.

The water absorption, arrival time and degree of softening for composite doughs (wheat and barley flour) were showed increase compared to control dough, whether adding the sorghum flour lead to decrease of water absorption but increasing of arrival time, dough development and degree of softening.

Also, the same additive levels of barley and sorghum flour ought to increase the breads weight. On the other hand, amino acids analysis cleared that incorporation with composite flours improved the concentration of cystine, lysine, methionine, tyrosine,

phenylalanine, threonine, tryptophan and total essential amino acids compared to the control.

As regard to sensory evaluation of resulted balady breads showed that there were slight differences (P ≤ ٠.٠٥) between control and formulas of barley and sorghum breads (with their levels of ١٥, ٢٠, ٢٥ , ٣٠ ٣٥%) were the closet to control.

INTRODUCTION

Bread is traditionally made from wheat flour. Other cereal flours like rye, barley, sorghum and maize have been used either alone or in combination with wheat flour for bread making in various parts of the world (Samuel, ١٩٧٢).

Cereal grains contain the macronutrients (protein, fat and carbohydrate) required by humans for growth and maintenance. They also supply important minerals, vitamins and other micronutrients essential for optimal health. The researches were concerned on the production of bio-fuel, particularly in the countries having surplus of grains production. This caused a reduction in the quantity of grains in the world market and sequently an increase in their prices. Therefore, efforts have been done to prepare bread from a composite flour of wheat and others locally grown crops such as cassava, plantain, cocoyam, soy bean,…etc (Giami *et al*., ٢٠٠٤; Essien, ٢٠٠٦; Olaoye *et al*., ٢٠٠٦ and Eddy *et al*., ٢٠٠٧).

Composite breads are breads made from blends of wheat and non-wheat flours (Dendy, ١٩٩٢). Those flours are advantageous to developing countries because they reduce wheat imports and enable the use of locally grown grains. Sorghum is an important cereal crop grown in many developing countries that is potentially suitable for use in composite flours. Although the use of sorghum flour in composite bread appears promising in terms of loaf volume and crumb structure, its use in bread making may not be straightforward. The starch gelatinization temperature is high compared with that of wheat. This factor and a lower water holding capacity (WHC) of sorghum flour may be responsible for the grittiness, dry mouth feel and higher firming ratio of sorghum composite breads (Munck, ١٩٩٥).

Interest in foods rich in dietary fibers has increased recently because of its beneficial effects in various degenerative diseases.

Production of balady bread

Barley is unique among cereals because of its high concentration of soluble dietary fibers, particularly mixed linked ١ → ٣ and ١ → ٤ β-D glucans. This material has been studied in connection with its hypocholesterolemic effects in animals and humans (Kalra and Jood, ٢٠٠٠). Such composite flour can be used for producing bread, biscuits and other snacks. By making more extensive use of cereals other than wheat and pulses especially barley and soy bean, diversified and functional food products could be prepared (Eddy *et al.*, ٢٠٠٧).

The present investigation was undertaken to study the effect of supplementation of wheat flour with either barley or sorghum flours at ١٥, ٢٠, ٢٥, ٣٠ and ٣٥٪ levels on the functional, baking and organoleptic characteristics of balady bread.

MATERIALS AND METHODS

Materials:

Wheat flour (٨٢٪ extraction) was taken from Upper Egypt Mills Company, El-Minia governorate. Barley and white sorghum grains were obtained from Agronemy Department, Faculty of Agriculture, Minia University. Yeast and salt were purchased from the local market, El-Minia.

Methods:

Samples preparation: The first sample was wheat flour (٨٢٪ extraction). Composite flours (ten samples) were prepared from wheat flour substituted with either barley or sorghum flours at ١٥, ٢٠, ٢٥, ٣٠ and ٣٥٪ levels.

Analytical methods: The proximate chemical composition (moisture, ash, crude protein and crude fat) of wheat, barley and sorghum flours and breads were determined according to the methods of the AOAC (١٩٩٥) after drying for ١٢ hrs at ٤٠-٥٠ºC using an electrical air draught oven and grinding. Carbohydrates were calculated by difference.

Calories determination: Calories of wheat composite flours and breads were calculated as reported by Greenfield and Southgate (١٩٩٢) applying the factors: ٤, ٩ and ٤ for each gram of protein, oil and carbohydrate, respectively.

Amino acids analysis was determined using Beckman amino acid analyzer (model ١١٨/١١٩ CL) according to the method described by Moore and Stein (١٩٦٣).

Rheological properties of composite flour dough: water absorption, development time, dough stability, arrival time and degree of softening of the various formulas were determined using a Barbender Farinograph with a ١٠٠ mixing bowel according to AACC (١٩٨٣).

Preparation of balady breads:

For preparing breads, the flour, salt, yeast and water were weighed and mixed together to obtain the bread dough. Control dough was made from ١٠٠٪ wheat flour (٨٢٪ extraction). Five dough samples were prepared from wheat flour substituted with barley flour at ١٥, ٢٠, ٢٥, ٣٠ and ٣٥٪ levels. The other five dough samples were prepared from wheat flour substituted with sorghum flour at the same mentioned above substitution levels. The blends were processed and baked in the bakery of El-Minia University. The obtained breads were cooled for an hour at room temperature, then, the weight (gm) and diameter (cm) of fresh breads were assessed.

Sensory evaluation of balady breads:

Fresh breads were served to ten experienced judges (staff members of Food Science and Technology Department, El-Minia University). General attribute ranking evaluations were made in individual tables under fluorescent light at ambient temperature (٢٥ºC). Five sensory attributes were evaluated (crust color, crumb properties, taste, flavor and overall acceptance) using method according to Amerine *et al*. (١٩٦٥). Accuracy and precision were statistically evaluated.

Statistical analysis:

Sensory properties of wheat composite breads and control were statistically analyzed with the GLM(General Linear Model) program using Statistical Analysis System (SAS, ١٩٨٦). Significant differences between treatments were determined at the ٥٪ level.

RESULTS AND DISCUSSION

Proximate chemical composition of various flours and breads:

Proximate composition of wheat, barley and sorghum flours are shown in Table (١), which cleared that wheat flour recorded the highest percent of moisture (١١.٧٠٪), followed by barley flour (٨.٩٦٪) and sorghum (٨.٤٤٪). While barley flour showed the highest values of protein (١٤.٣٥٪), ash (٢.٣٠٪) and fat (١.٩٩٪). On the other side, sorghum flour contained the highest percent of carbohydrate (٧٥.٧٢٪) and calories (٣٦٧.٥٨), followed by wheat flour (٧٣.١٦٪) and barley flour (٧٢.٤٠٪). But sorghum flour has the lowest level of protein (١٢.٣٥٪).

Table ١: Chemical composition of various flours.

Constituents (%)	Types of flour		
	Wheat	Barley	Sorghum
Moisture	١١.٧٠	٨.٩٦	٨.٤٤
Ash	٠.٥٧	٢.٣٠	١.٧٩
Fat	١.٦١	١.٩٩	١.٧٠
Protein	١٢.٩٦	١٤.٣٥	١٢.٣٥
Carbohydrate*	٧٣.١٦	٧٢.٤٠	٧٥.٧٢
Calories**	٣٥٨.٩٧	٣٦٤.٩١	٣٦٧.٥٨

* Calculated by difference. ** (Kcal/١٠٠g).

The proximate composition of breads made from composite flours are shown in Table (٢).

Table ٢: Chemical composition of balady bread producing from wheat and composite flours.

Types of bread		Constituents (%)					
		Moisture	Ash	Protein	Fat	Carbohydrate*✱	Calories
Control✱		٣٦.٢٥	١.٧٦	١٢.٧٦	١.٩٩	٤٧.٢٤	٢٥٧.٩١
Barley (%)	١٥	٤٣.٧٥	١.٩٣	١٣.٦٤	٢.٢٩	٣٧.٣٩	٢٢٤.٧٣
	٢٠	٤٢.٧٦	١.٩٠	١٣.٧١	٢.٢٣	٣٩.٤٠	٢٣٢.٥١
	٢٥	٤٢.٩٠	١.٦٠	١٤.٣٦	٢.٣٣	٣٨.٨١	٢٣٣.٦٥
	٣٠	٤٣.٢٠	٢.٠٤	١٤.٤٦	٢.٧٤	٣٨.٠٧	٢٣٤.٧٨

	٣٥	٤٤.٢٠	١.٩٥	١٥.٢٢	٢.٢١	٣٦.٤٢	٢٢٦.٤٥
Sorghum (%)	١٥	٤٢.٥٦	٢.٧٣	١٢.٢٨	٢.٢٦	٤٠.١٧	٢٣٠.١٤
	٢٠	٤٢.٨٠	٢.٢٠	١٢.٤٦	٢.١٨	٤٠.٣٦	٢٣٠.٩٠
	٢٥	٤٢.٣٠	٢.٥٢	١٢.٠٦	٢.٠٤	٤١.٠٨	٢٣٠.٩٢
	٣٠	٤٣.٨٠	٢.٤٢	١٢.٧٧	١.٧٢	٣٨.٢٩	٢١٩.٧٢
	٣٥	٤٣.٤١	٢.٢٢	١٢.٨٠	٢.١٢	٣٩.٤٥	٢٢٨.٠٨

** * Calculated by difference. ✱control from wheat flour only.

As regared to moisture content, the bread from wheat flour has the lowest value of moisture, fat and ash but has the highest level of carbohydrae and calories. On the other hand, the breads from wheat composite flours (barley flour) had the highest contents of moisture, protein, ash and fat but it had lower contents of carbohydrae and calories as compared with control. These results in a good agreement with Park *et al*. (١٩٩٧) and Shittu *et al*. (٢٠٠٧) who use the composite cassava-wheat flour.

It was cleared from the data in Table (٢) that adding the sorghum flour to wheat flour resulted an increment in moisture, ash and fat(except at level ٣٠ %) while it had reduction in protein, carbohydrae and calories contents (except at levels ٣٠ and٣٥٪)

Rheological properties of control and composite flours:

Farinograph properties of wheat flour and composite flours (١١ samples) are shown in Table (٣).

Table ٣: Farinograph characteristics wheat and composite wheat flour with barley, sorghum and their blends.

Types of flour		Farinograph properties				
		Water absorption (%)	Arrival time (min)	Dough development time (min)	Dough stability (min)	Degree of softening (B.U)
Control✱		٦١.٢٠	١.٠٠	٢.٠٠	٨.٠٠	٥٠.٠٠
Barley (%)	١٥	٦٢.٤٠	١.٠٠	٢.٠٠	٧.٠٠	٨٠.٠٠
	٢٠	٦٣.٨٠	١.٥٠	٢.٥٠	٨.٠٠	٦٠.٠٠
	٢٥	٦٤.٧٠	١.٥٠	٢.٥٠	٨.٥٠	٦٠.٠٠
	٣٠	٦٥.٩٠	١.٠٠	٢.٥٠	٨.٥٠	٥٥.٠٠
	٣٥	٦٦.١٠	١.٥٠	٣.٠٠	١٠.٠٠	٥٠.٠٠

Sorghum (%)	١٥	٦١.١٠	١.٥٠	٤.٥٠	٨.٠٠	٦٠.٠٠
	٢٠	٥٩.٨٠	٣.٥٠	٥.٥٠	٥.٥٠	٨٠.٠٠
	٢٥	٥٩.٨٠	٣.٥٠	٦.٠٠	٨.٠٠	٦٠.٠٠
	٣٠	٥٨.٩٠	٤.٠٠	٦.٥٠	١٠.٥٠	٥٠.٠٠
	٣٥	٦٠ ١٠	٤.٥٠	٦.٠٠	< ١٢.٠٠	-

✱ control from wheat flour only.

It was cleared that water absorption, arrival time, dough stability and softening degree of composite flour (wheat and barley flours with different levels) were higher compared to control. These as the results reported by El-Soukkary (١٩٩٥) and Ayo (٢٠٠١). While, the blends of wheat and sorghum flours showed a decrease in water absorption. These results are in agreement with those reported by El-Kalifa and El-Tinay (٢٠٠٢).

The increase in fiber was also affected the dough development time as reported by El-Soukkary (١٩٩٥). Therefore, wheat flour had the lowest dough development time, while composite flour containing sorghum flour had the highest dough development time and dough stability than the others. This may be due to their high viscosities owing to their higher contents of soluble fibers. These results agreed well with those reported by Park *et al.* (١٩٩٧).

Weight and diameter of breads:

It was cleared from the data in Table (٤) that adding of barley and sorghum to wheat flours at ١٥, ٢٠, ٢٥, ٣٠ and ٣٥٪ levels caused an increase in the weight of breads and slight decrease in diameter with all levels of blends. These results in agreement with Park *et al.* (١٩٩٧) and Shittu *et al.* (٢٠٠٧).

Table ٤: Effect of using the wheat composite flour on weight (gm) and diameter (cm) of bread.

Properties	Types of bread		
	Control✱	Barley (%)	Sorghum (%)

		١٥	٢٠	٢٥	٣٠	٣٥	١٥	٢٠	٢٥	٣٠	٣٥
Weight	١٣١	١٣٨	١٣٧	١٣٦	١٣٧	١٣٨	١٣٢	١٤٥	١٣٨	١٤٢	١٣٧
Diameter	١٨.٧٠	١٨.٠٠	١٨.٠٠	١٨.٥٠	١٨.٥٠	١٨.٥٠	١٨.٥٠	١٩.٠٠	١٩.٠٠	١٩.٠٠	١٨.٠٠

✱ control from wheat flour only.

Amino acids composition of breads:

Data presented in Table (٥) showed the amino acid composition of wheat and wheat composite flour breads. The use of composite flours appeared to increase and decrease the concentration of some amino acids according to the level of subsitution, compared to the control. With comparison of the amino acid composition of wheat composite breads, it cleared that the breads contained similar or higher contents of total essential amino acids than the FAO/WHO (١٩٧٣) protein reference pattern, except for modest deficiencies, especially in leucine and iso leusine.

Table ٥: Amino acids composition of wheat and wheat composite flour breads.

Amino acids (AA.)	Types of bread											FAO/ WHO (١٩٧٣)
	Control ✱	Barley (%)					Sorghum (%)					
		١٥	٢٠	٢٥	٣٠	٣٥	١٥	٢٠	٢٥	٣٠	٣٥	
Cystine	١.٧٧	١.٦٢	٢.٠٤	٢.٣٩	١.٩٠	٢.٣٤	٢.٤٥	١.٤١	٢.١٨	١.٩٨	٢.٢٦	-
Isoleucine	٣.٦٧	٣.٨٢	٣.٤٢	٣.٦٨	٣.٥٥	٣.٦١	٣.٧٣	٣.٩٥	٣.٤٧	٣.٤٧	٣.٥٣	٤.٠٠
Leucine	٧.٨٨	٨.٣١	٦.٦٢	٢.٤٦	٧.٥٠	٢.٥	٢.٣٩	٨.٦٥	٢.٦٠	٧.١٠	٢.٥٦	٧.٠٠
Lysine	٢.١٨	٢.٠٥	٢.٣٨	٣.٠٤	٢.٢٧	٢.٨٣	٣.١٨	١.٩١	٢.٥٥	٢.٣٤	٢.٧٢	٥.٥٠
Methionine	١.٦٢	١.٤١	٢.٠٠	١.٩٠	١.٧٧	١.٩٤	١.٨٧	١.٣٢	٢.٠٠	١.٩١	٢.٠٠	-
Total sulphur AA.	١٧.١٢	١٧.٢١	١٦.٤٦	١٣.٤٧	١٦.٩٩	١٣.٢٢	١٣.٦٢	١٧.٢٤	١٢.٨٠	١٦.٨٠	١٣.٠٧	٣.٥٠
Tyrosine	٢.٦٦	٢.٣٨	٣.١٠	٣.٥٣	٢.٨٨	٣.٤٩	٣.٦٥	٢.١٢	٣.٢٤	٣.٠٠	٣.٣٧	-
Phenylalanine	٤.١٠	٣.٩٢	٤.٥٣	٤.٠١	٤.٢٥	٤.١٨	٣.٧٨	٣.٧٧	٤.٤٥	٤.٤٠	٤.٣٧	-

Total aromatic AA.	٦.٧٦	٦.٣٠	٧.٦٣	٧.٥٤	٧.١٣	٧.٦٧	٧.٤٣	٥.٨٩	٧.٦٩	٧.٤٠	٧.٧٤	٦.٠٠
Threonine	٢.٤٣	٢.٣١	٢.٦٢	٣.٠٥	٢.٥٠	٢.٩٦	٣.١٧	٢.١٣	٢.٧٥	٢.٥٨	٢.٨٣	٤.٠٠
Tryptophan	٠.٩٥	٠.٨٩	١.١٢	١.٣٦	١.٠١	١.٣١	١.٤٥	٠.٩٧	١.١٧	١.١٠	١.٢٣	١.٠٠
Valine	٤.٠١	٤.١١	٣.٧١	٤.٥٣	٣.٩٤	٤.٣١	٤.٧٥	٤.٢٧	٣.٩١	٣.٨٠	٤.١٥	٥.٠٠
Total essential AA.	٧.٣٩	٧.٣١	٧.٤٥	٨.٩٤	٧.٤٥	٨.٥٨	٩.٣٧	٧.٣٧	٧.٨٣	٧.٤٨	٨.٢١	٣٦.٠٠
Histidine	١.٤١	١.١٠	٢.٠٤	٢.٦٤	١.٧٠	٢.٥٩	٢.٧٣	٠.٧٨	٢.١٢	١.٨٨	٢.٢١	-
Arginine	٤.١٢	٤.٠٠	٤.٣١	٤.٨٧	٤.٢١	٤.٧٥	٥.٠٨	٣.٧٩	٤.٤٣	٤.٢٧	٤.٦٣	-
Aspartic acid	٥.٢٦	٥.٥١	٤.٤٥	٥.٦٢	٥.٠٢	٥.٢٨	٥.٨٦	٥.٧٠	٤.٧٨	٤.٧٠	٥.٠٨	-
Glutamic acid	٣٠.١٠	٢٩.٨٩	٣٠.٥١	٢٥.٦٠	٣٠.٢٥	٢٦.٨٢	٢٤.٤١	٢٩.٦٦	٢٩.٣٠	٣٠.١٨	٢٨.٠٠	-
Serine	٤.٦٦	٤.٥١	٤.٣٦	٤.٦٣	٤.٥٧	٤.٥٩	٤.٧٢	٤.٣٤	٤.٤٢	٤.٤٨	٤.٥١	-
Proline	٩.١٨	٩.٠٠	٩.٨٦	٧.١٨	٩.٤٠	٨.٢١	٥.٨٩	٨.٧٦	٩.٦٠	٩.٦١	٩.٠٠	-
Glycine	٣.١٥	٣.٠٠	٣.٥٨	٤.٥٣	٣.٢٧	٤.٠٨	٥.٠٧	٢.٧٧	٣.٧١	٣.٤٢	٣.٨٣	-
Alanine	٥.٠٤	٥.٣٨	٣.٢١	٣.٨٣	٤.٥١	٣.٧١	٣.٩٧	٥.٦٢	٣.٤١	٣.٩٩	٣.٥٩	-
Total non-essential AA.	٦٢.٩٢	٦٢.٣٩	٦٣.٣٢	٥٨.٩٠	٦٢.٩٣	٦٠.٠٣	٥٧.٧٣	٦١.٤٢	٦١.٧٧	٦٢.٥٣	٦٠.٨٥	-

✱ control from wheat flour only.

Sensory properties of breads:

Sensory evaluation of wheat and wheat composite flour breads are shown in Table (٦). There were no significant differences (P ≤ ٠.٠٥) in color, crumb properties, taste, flavor, overall acceptance between control and the wheat composite flour (with barley) breads to level ٣٠% . Meanwhile it found asignificant differencess (p≤٠.٠٥) at level ٣٥٪. the closest to control. These results consistency well with those reported by Gujral and Pathak (٢٠٠٢) who found that upon storage to ٢٤ hrs, the extensibility and energy to rupture chapaties made from supplemented whole wheat flour with rice, corn, barley, millets and black gram decreased and showed higher extensibility even after ٢٤ hrs of storage, especially barley. While composite flour

containing sorghum were the lowest among the breads but still acceptable to level ٣٠٪ .These results agreed well with Park *et al*. (١٩٩٧) who stated that the fiber bread showed a ١٠٪ reduction in loaf volume and a somewhat inferior crumb grain with an off color.

Table ٦: Sensory evaluation of wheat and wheat composite flour breads.

Types of bread		Sensory properties				
		Crust color	Crumb properties	Taste	Flavor	Overall acceptance
Control*		٩.٣٩^{a}	٨.٤٤^{ab}	٨.٧٢^{ab}	٨.٤٤^{a}	٨.٩٤^{a}
Barley (%)	١٥	٩.١١^{ab}	٨.٧٢^{ab}	٨.٦١^{ab}	٨.٥٠^{abc}	٨.٧٢^{a}
	٢٠	٩.٥٠^{a}	٨.٩٤^{a}	٩.٢٨^{a}	٩.٠٠^{a}	٩.١١^{a}
	٢٥	٩.٠٦^{ab}	٨.٩٤^{a}	٨.٨٩^{ab}	٨.٥٠^{abc}	٨.٨٩^{a}
	٣٠	٩.١٧^{ab}	٨.٣٣^{ab}	٨.٧٢^{ab}	٨.٦٧^{ab}	٨.٨٩^{a}
	٣٥	٨.٢٢^{bc}	٧.٣٩^{bc}	٧.٦٧^{bc}	٧.٨٩^{abc}	٧.٩٤^{ab}
Sorghum (%)	١٥	٧.٩٤^{c}	٧.٥٦^{bc}	٧.٣٩^{c}	٧.٤٤^{cd}	٧.٥٠^{b}
	٢٠	٧.٨٩^{c}	٧.٦١^{abc}	٧.٣٣^{c}	٧.٣٣^{cd}	٧.٤٤^{bc}
	٢٥	٧.٥٠^{c}	٦.٥٦^{c}	٦.٦١^{c}	٦.٧٢^{d}	٦.٢٨^{c}
	٣٠	٧.٣٩^{c}	٦.٨٣^{c}	٧.٢٢^{c}	٧.١١^{d}	٧.١١^{bc}
	٣٥	٤.٨٩^{d}	٤.٣٩^{d}	٤.٥٦^{d}	٤.٨٣^{e}	٤.٣٣^{d}

Abcde mean values in the same column not followed by the same letter are significantly different (P ≤ ٠.٠٥).

* control from wheat flour only.

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Production of balady bread

دراسات على الدقيق المركب وتأثيره على تصنيع الخبز البلدي

سناء أحمد محمد صالح الشريف

قسم علوم الأغذية – كلية الزراعة – جامعة المنيا

تم استعمال دقيق القمح المركب في تصنيع عشر خلطات من دقيق القمح المركب من بعض الحبوب بالإضافة إلى عينة المقارنة (دقيق قمح استخراج ٨٢%) تلك التي تم استخدامها في عمل خبز بلدي مدعم. وتتكون الخلطات من عينة المقارنة بالإضافة إلى خمسة مستويات لكل خلطة من دقيقي الشعير والذرة وهي ١٥ ، ٢٠ ، ٢٥ ، ٣٠ و ٣٥%. وتم عمل بعض الدراسات لتقييم الخصائص التغذوية والريولوجية والحسية للمواد الخام والخبز الناتج من دقيق القمح والقمح المركب.أوضحت نتائج التحليل الكيميائي للمواد الخام احتواء دقيق الشعير على أعلى نسبة من الرماد و البروتين والدهن ، يليه دقيق الذرة الرفيعة إلا أنه يحتوي على أقل نسبة بروتين مقارنة بدقيق القمح. كما أن دقيق الذرة الرفيعة له أعلى نسبة كربوهيدرات ، يليه دقيق الشعير وأقلها كان دقيق القمح. ادى تدعيم دقيق القمح بدقيق الشعير إلى زيادة معدلات البروتين والدهن والرماد في الخبز الناتج ، بينما انخفضت معدلات الكربوهيدرات والسعرات الحرارية.

أوضحت النتائج ايضآ زيادة امتصاص الماء ، وقت الوصول ودرجة الإضعاف للعجينة المركبة بالنسبة لدقيق القمح ودقيق الشعير مقارنة بالكنترول ، بينما أدت إضافة دقيق الذرة الرفيعة إلى نقص الماء الممتص وزيادة في وقت الوصول وتطور العجينة ودرجة الإضعاف.أدت نفس معدلات الإضافة من الشعير والذرة إلى زيادة في وزن الخبز الناتج .. من ناحية أخرى أوضحت تقديرات الأحماض الأمينية أن إضافة الدقيق المركب قد أدى لتحسن تركيزات كل من السستين ، الليسين ، الميثيونين ، التيروزين ، الفينيل ألانين ، الثريونين ، التربتوفان والأحماض الأمينية الأساسية الكلية مقارنة بعينة المقارنة.

أوضحت نتائج التقييم الحسي للخبز البلدي الناتج وجود اختلافات طفيفة بين عينة المقارنة والعينات المدعمة بكل من دقيق الشعير ودقيق الذرة الرفيعة عند كل المعدلات (١٥ ، ٢٠ ، ٢٥ ، ٣٠ و ٣٥%) حيث كان أقرب لعينة المقارنة