TABLE II
Farinograph Parameters of Wheat Flour Dough and Tomato Seed Flour Blends

Sample	Water Absorption (%)	Dough Development Time (min)	Dough Stability (min)	Mixing Tolerance Index (BU)	Dough Weakening (BU)
Control	57.5	3.2	6.5	60	70
Whole tomato seeds (%)					
5	57.7	4.3	8.2	90	65
10	58.1	3.5	7.0	80	75
15	58.3	3.5	5.7	70	82
Defatted tomato seeds (%)					
5	58.1	4.5	9.0	75	70
10	58.8	4.5	8.6	70	60
15	59.8	4.5	8.4	50	67

TABLE III
Extensigraph Parameters of Wheat Flour Dough and Tomato Seed Flour Blends

Sample	Extensibility (mm)	Resistance to Extension (BU)	Dough Energy (cm^2)	Proportional Number[a]
Control	110	430	85.75	3.90
Whole tomato seeds (%)				
5	98	400	81.50	4.08
10	87	375	72.00	4.31
15	77	347	63.80	4.51
Defatted tomato seeds (%)				
5	92	408	79.00	4.43
10	73	400	65.90	5.48
15	71	377	57.00	5.31

[a] Resistance to extension divided by extensibility.

TABLE IV
Effect of Adding Tomato Seed Meal to Wheat Flour on Gas Production

Sample	Gas Production (mm of Hg, in min)								
	0	15	30	45	60	75	90	105	120
Control	0	10	28	58	112	158	206	256	284
Whole tomato seeds (%)									
5	0	16	42	82	132	178	230	286	···
10	0	16	45	88	150	200	255	296	···
15	0	18	58	110	166	226	290	···	···
Defatted tomato seeds (%)									
5	0	14	34	64	115	162	215	265	290
10	0	14	34	74	116	168	220	278	295
15	0	15	33	78	116	170	222	283	298

The flattened loaves were proofed at 30–35°C and 85% relative humidity for 15 min and then were baked at 400–500°C for 1–2 min. The loaves of bread were allowed to cool on racks for about 1 hr before evaluation.

Analytical methods. Moisture, ash, protein, crude fiber, and fat were analyzed according to AOAC methods 14.004, 14.006, 2.057, 7.065, and 14.018 (AOAC 1980). Evidence of gassing power was based on the AACC manometric method 22-11 (AACC 1962). Rheological properties of the doughs were analyzed with an extensigraph and a farinograph according to AACC methods 54-10 and 54-21, respectively (AACC 1962).

Ten panelists were asked to evaluate bread for appearance, separation of layers, roundness, crumb distribution, taste, odor, and crust color according to the method of Kramer and Twigg (1974).

Whole and defatted tomato seed meal and wheat flour were analyzed for total protein, total lipids, moisture, crude fiber, and ash content.

RESULTS AND DISCUSSION

Chemical Analysis of Tomato Seed Meal and Wheat Flour

Percents of protein, fat, crude fiber, and ash in the whole tomato seed meal were higher than those in wheat flour (Table I). These values agreed with those reported by Rakhmetova (1980), who found that the total protein and fat of tomato seed were 32.0 and 25.5%, respectively.

Rheological Properties of the Dough

Farinograph test. Absorption, dough development time, and stability increased when whole or defatted tomato seed meal was blended with wheat flour (Table II). However, within blends, as the level of whole and defatted tomato seed meal increased, the dough stability and mixing tolerance index decreased.

Extensigraph test. The substitution of tomato seed meal for wheat flour decreased extensibility, resistance to extension, and dough energy of the wheat flour (Table III). The proportional number increased as the percentage of whole or defatted tomato seed meal increased.

Gassing Power Test

Experiments proved that the addition of whole or defatted tomato seed meal to wheat flour increased gas (CO_2) production (Table IV). The fermentation time for blended whole and defatted tomato seed meal with wheat flour at a 15% replacement level decreased by 25.0 and 12.5%, respectively. The higher gas production or shorter fermentation time may be due to the fermentable sugars in the added tomato seed meal.

Baking Test and Organoleptic Qualities of Balady Bread

The supplementation effects of tomato seed meal on balady bread quality are shown in Table V. A slight increase in loaf weight occurred after baking due to the enhanced absorption of moisture (Table II). Loaf diameter also improved as a result of adding 10% or more of tomato seed meal to the dough formula. With respect to the organoleptic evaluation of the bread produced, the overall quality correlates with the ratio of the tomato seed meal (Table V). The 5 and 10% recipes received a fancy grade in quality measurements as described by Kramer and Twigg (1974), while the other recipe (15%) received an extra standard grade in quality. The crust and crumb of the breads fortified with 5% tomato seed meal were golden; at higher levels of supplementation, they were darker. These results are in agreement with those of Mokhnacheva et al (1975). They reported that wheat breads baked with 1 or 2% tomato seed flour added to wheat flour were equal in quality to control wheat bread, but greater additions resulted in crumb darkening.

Taste scores decreased as the level of tomato seed meal increased. A slightly bitter taste at a 10% or greater replacement level may be due to a steroid compound found in crushed tomato seed (Zagibalov et al 1985).

Effect of Baking and the Addition of Tomato Seed Meal on Major Chemical Constituents of Balady Bread

Table VI shows the chemical composition of balady bread prepared from wheat flour with the addition of tomato seed meal. The protein content of the control bread was higher than that of the wheat flour (Table I), which may be attributed to the presence of bran coating on the bottom of the loaves or to the added quantities of yeast. Tomato seed meal is characterized by its high protein content. As expected, therefore, the protein

TABLE V
Measurements and Quality Characteristics of Balady Bread Made with Wheat Flour/Tomato Seed Meal Blends

	Control	Whole Tomato Seed Meal			Defatted Tomato Seed Meal		
		5%	10%	15%	5%	10%	15%
Measurement							
Weight after baking (g)	94.0	94.0	95.0	95.8	95.0	95.6	97.0
Moisture content (%)	34.0	34.4	35.0	36.0	35.5	36.3	37.0
Diameter after baking (cm)	17.5	17.5	18.0	18.5	17.5	18.5	18.0
Quality							
General appearance (20)	17.6	17.5	17.2	16.4	18.4	17.5	11.9
Separation of layers (20)	18.0	18.2	18.1	16.6	19.0	17.7	14.0
Roundness (15)	13.7	13.8	13.7	13.1	14.3	12.6	10.0
Crumb distribution (15)	13.6	14.2	13.8	12.8	14.3	13.6	10.8
Taste (10)	8.3	7.4	6.8	5.6	8.6	5.9	4.1
Odor (10)	8.0	8.1	7.7	7.1	8.9	7.6	6.4
Crust color (10)	7.9	7.5	7.8	7.2	8.8	7.4	5.4
Overall quality (100)	87.1	86.7	85.1	78.8	88.7	82.3	62.6

TABLE VI
Major Chemical Constituents of Balady Bread Made from Wheat Flour plus Tomato Seed Meal (%, dry weight basis)

Sample	Protein	Fat	Fiber	Ash
Control	11.40	1.34	1.72	2.20
Whole tomato seeds (%)				
5	12.62	2.21	2.60	2.30
10	13.50	3.43	3.55	2.42
15	14.71	4.00	4.63	2.50
Defatted tomato seeds (%)				
5	13.00	1.23	2.81	2.39
10	14.72	1.18	3.92	2.48
15	16.22	1.00	5.10	2.60

content of the bread samples was increased as a result of the addition of tomato seed meal. The same trend was also noticed for the ash and fiber contents and probably could be explained by the fact that tomato seed meal contains high levels of ash and crude fiber.

It was also noted that the addition of whole tomato seed meal to wheat flour resulted in a large increase in the fat content of the bread, while the addition of defatted tomato seed meal lowered the fat content.

Based on these results, it could be recommended that tomato seed be used to supplement wheat flour in making balady bread.

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