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Using of Taro Flour as Partial Substitute of Wheat Flour in Bread Making

[1]M.S. Ammar, [1]A.E. Hegazy and [2]S.H. Bedeir

[1]Food Science and Technology Department,
Faculty of Agriculture, AL-Azhar University, Cairo, Egypt
[2]Food Technology Research Institute, Agriculture Research Center, Giza, Egypt

Abstract: This study investigated the effects of using taro flour as partial substitution of wheat flour in balady bread (Egyptian bread) making with substitution levels of 5,10,15 and 20% on the farinograph, extensograph properties of the produced doughs, organoleptic properties and chemical composition of the produced bread. The Farinograph results showed that the increase of substitution level increase the water absorption and dough weakening but decrease the mixing time and dough stability, while the results of extensograph showed that dough energy, the resistance to extension and the proportional number decreased with the increasing the taro flour level in the flour blends, while the dough extensibility increased. While the organoleptic evaluation showed that the substitution of wheat flour with taro flour up to 10 % produce bread similar to the control (wheat bread) in all the organoleptic properties. Also, the increase of the taro flour level resulted in decreasing in the crude protein and ether extract while, ash, total carbohydrates and fiber contents increased. It could be concluded that the substitution of wheat flour with taro flour in bread making with substitution level up to 10 % produce bread with rheological and organoleptic properties similar to the wheat flour bread.

Key words: Taro flour · Balady bread · Rheological properties · Chemical composition

INTRODUCTION

In recent years, the demand to use novel sources as substitute for the wheat flour was increased to provide the consumers requirements, therefore some roots, including cassava (*Manihot esculenta Crantz*) and sweet potato (*Ipomoea batatas*), some tubers including potato (*Solanum tuberosum*) and yam (*Dioscorea spp.*) and some edible aroids, including taro (*Colocasia esculenta*) and cocoyam (*Xanthosoma sagittifolium*) were used as important calorie sources and wheat flour substitutes [1]. Taro (*Colocasia esculenta)* is one of the most widely cultivated edible aroids in the tropical and subtropical countries. The total taro production in the world is about 9.22 million tons from an area of 1.57 million hectares [2] covering South East Asia, Pacific Islands, Hawaii, Philippines, Africa, Egypt, West Indies and certain areas of South America[2]. The research and development of tuber and root crops have been neglected even though these staple crops are clearly important in the tropics as part of the food industry and as animal feed [1,2]. This neglect is partially attributed to the assumption that these tuber/root crops are inferior because of their lower price than cereals and low protein content. Taro has been reported to have 70–80 % starch with small size granules [3], which result in high digestibility, so it is used in preparation of infant foods in Hawaii and other Pacific islands [4]. These aroid flours could be advantageous in the preparation of myriad products by the food development industry, since it could be used in dehydration soup formation, baked goods, formulation of baby food, snacks, breakfast products and so on. Finally, aroid flours could also become a useful source of starch not only for food items but also for other industries such as drug, textile, paper, oil production and bread making [5, 6]. According to Essien [7], the possibility of using starchy staples for bread making depends on the physical and chemical properties of the product. On the light of this, cocoyam, cassava, taro and other tubers crops have been found to be an alternative sources of major raw materials for bread making [8]. In this study, taro flour was used as partial substitute of 5, 10, 15 and 20 % in bread making and its effects on the rheological properties, organoleptic and chemical characteristics of composite bread were investigated.

Corresponding Author: M.S. Ammar, Food Science and Technology Department, Faculty of Agriculture, AL-Azhar University, Cairo, Egypt

MATERIALS AND METHODS

Materials: Commercial wheat flour of 82% extraction rate, taro (*Colocasia esculenta*), compressed yeast (a Local Strain of *Saccharomyces cerevisia*) and commercial sodium chloride (Salt) were obtained from the local market.

Methods

Preparation of Flour from Taro (*Colocasia esculenta*): Flour of taro (*Colocasia esculenta*) was obtained using the conventional dehydration techniques as described by Nip [6]. Taro was cleaned and rinsed with a large amount of tap water, peeled and manually sliced into approximately 2 to 3 cm thick round or cube pieces, which were dried at 45°C for 24h in an air dehydrator to ensure a constant weight. On layer of slice was placed on a tray in the dehydrator chamber and a constant flow of hot air was applied. Dried slices were fine milled into flours (with granules size pass through 60- mesh screen).

Flour Blends Formulation: Beside the control (100% wheat flour), the composite flours were prepared by substituting wheat flour with 5, 10, 15 and 20% taro flour which named WT1, WT2, WT3 and WT4, respectively by mixing in a blender (Braun, Germany), then packaged in polyethylene bags and stored in a desiccator until required for further analysis and processing into balady bread loaves (Egyptian bread consist of two layers).

Dough Rheology

Rheological Properties of Blended Flour Mixtures: Dough samples for the rheological experiments were prepared as those used in bread making, but without added yeast. Farinograph and extensograph properties were assessed according to the method described by A.A.C.C [9].

Preparation of Bread: The bread was prepared by mixing1000 gram of flour / flour blends with dried compressed yeast and water at 40°C, then the produced dough was left at room temperature for 30 min. to complete fermentation, then the dough was cut into loaves, which were baked at 400°C for 2 min, in a baker house at the Agriculture Research Center, Giza, Egypt. The baked loaves of each treatments divided into two parts one for the sensory evaluation and the other was dried in an oven at 70°C for 24 hr., finely ground to a powder and frozen stored in plastic bags at - 18°C until analyzed.

Bread Organoleptic Properties: The organoleptic properties of the baked control sample and testes bread samples were carried out according to the method of A.A.C.C. [9]. The organoleptic evaluation was made by ten trained subjects and the average score for each characteristic was calculated and statistically analyzed using L.S.D and multiple range tests according to Kramer and Twigg [10] using the Following score values for each characteristic: Appearance (20), Separation of layers (20), Roundness (15), Crumb (15), Crust (10), Taste (10), Odor (10) and Overall acceptability (100).

Gross Chemical Analyses: Bread samples under investigation were analyzed for moisture, Ash, fiber, ether extract and crude protein contents according to the method of A.O.A.C. [11]. Whereas total carbohydrates were calculated by subtraction.

RESULTS

Dough Rheological Properties

Farinograph Properties: Table 1 and Fig. 1 indicate the farinograph parameters of the control and wheat taro flour blends (WT). The Table shows that the water absorption increased as the wheat flour substitution level increased, It increased from 56 for control to 57.5, 58.5, 59.and 59.5% for WT1, WT2, WT3 and WT4, respectively. Regarding to mixing time, the blend which containing 20 % taro flour (WT4) exhibited the longer mixing time (3.5 min.), while the mixing time of control and the blend containing 10 % taro flour (WT2) was 2.5 min. but the other two treatments (WT1 and WT3) exhibited the shorter mixing time (2 min.). Also, the control and WT2 blend showed the same dough stability (4 min.), while the other tested blends had lower dough stability (3.5 min). On the other hand, the dough weakening increased proportionally from 100 B.U for control to 110 B.U for WT1 but decreased to 80 B.U for WT2, while dough weakening of WT3 and WT4 was similar to the of control.

Extensograph Properties: Table 2 and Fig. 2 indicate the extensograph parameters of the control and wheat taro flour blends (WT), which show that dough energy, the resistance to extension and the proportional number decreased with the increasing of the taro flour ration in the flour blends, while the dough extensibility increased in the first three blends (WT1, WT2 and WT3) but decreased in the fourth blend as compared to the control.

Table 1: Farinograph parameters of the control and wheat taro flour blends

Flour blends (%)	Water Absorption (%)	Mixing Time (min)	Dough Stability (min)	Dough Weakening (B.u)
Control	56	2.5	4.0	100
WT1	57.5	2.0	3.5	110
WT2	58.5	2.5	4.0	80
WT3	59	2.0	3.5	100
WT4	59.5	3.5	3.5	100

Table 2: Extensograph parameters of the control and wheat taro flour blends

Treatments	Dough Energy $(cm)^2$	Dough Extensibility (E) (m.m)	Resistance to Extension (R) (B.u)	Proportional Number (R/E)
Control	29	97	280	2.9
WT1	24	105	188	1.8
WT2	22	110	160	1.5
WT3	20	108	130	1.2
WT4	14	92	100	1.1

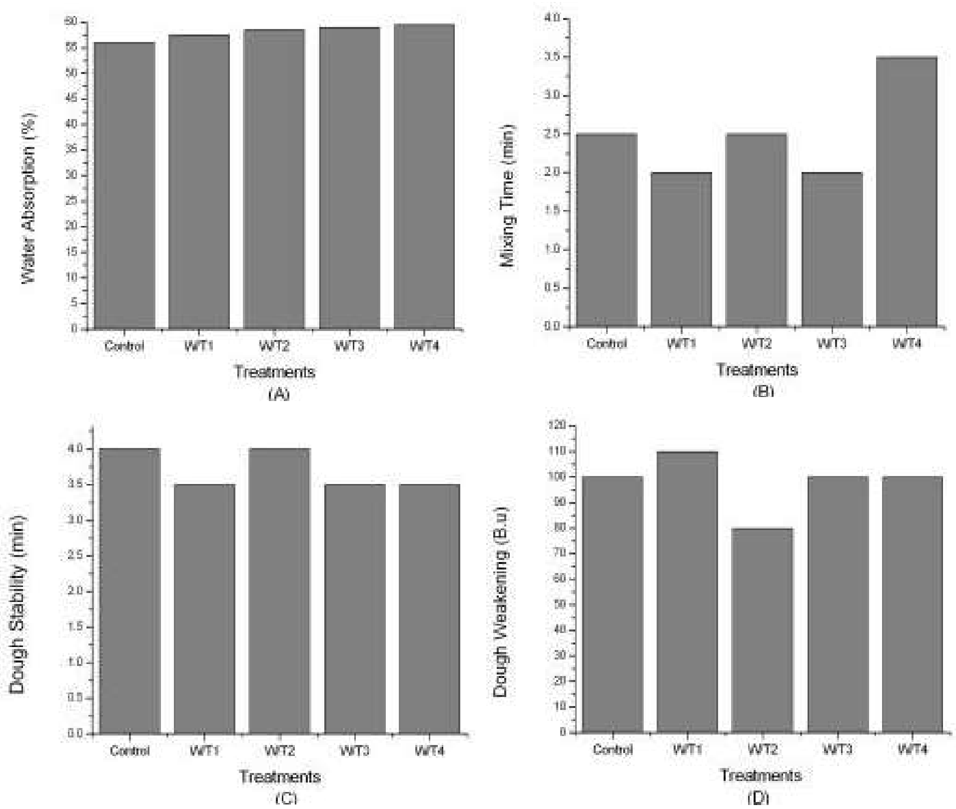

Fig. 1: Farinograph parameters of the control and wheat taro flour blends, where A, water absorption; B, mixing time; C, dough stability and D, dough weakening

Organoleptic Properties: Table 3 indicates sensory evaluation scores of the control and wheat taro flour balady bread loaves. The control bread and bread made of blends containing 5 and 10% taro flour (WT1 and WT2) were exhibited good organoleptic properties scores without any significant different among them, while the bread made of WT3 blend become in the second degree with significant difference ($p<0.05$) than the previous mentioned bread samples and the bread made of WT4 blend which exhibited the worth organoleptic properties. Finally, the increase of the substitution ratio resulted in decrease of the organoleptic quality of the produced bread samples.

Table 3: Organoleptic properties* of bread samples and average values scored for overall acceptability of bread samples

	Treatments				
Property	Control	WT1	WT2	WT3	WT4
Appearance	18.9[a]	18.9[a]	18.5[a]	17.0[b]	13.0[c]
Separation of layers	20.0[a]	19.8[a]	19.0[a]	15.0[b]	12.0[c]
Roundness	14.5[a]	14.5[a]	14.0[a]	13.0[b]	10.0[c]
Crumb	9.6[a]	9.6[a]	9.5[a]	7.5[b]	5.0[c]
Crust color	9.5[a]	9.5[a]	9.5[a]	8.5[b]	8.0[c]
Taste	9.0[a]	9.0[a]	8.5[a]	8.0[b]	6.5[c]
Odor	10.0[a]	9.5[a]	9.0[a]	8.0[b]	6.5[c]
Overall acceptability **	91.5[a]	90.8[a]	88.0[a]	77.0[b]	61[c]
Overall acceptability average ***	13.07[a]	13.0[a]	12.6[a]	11.0[b]	8.7[c]

*Means in the same row with the same superscripts are not significantly different (P= 0.05)

** Sum of the seven organoleptic properties

***Average of seven organoleptic properties

Table 4: Chemical Composition of wheat and wheat - taro breads

	Component (%)				
Treatments	Crude protein	Ether extract	Crude fiber	Ash	Total Carbohydrates
Control	11.78	1.67	1.15	0.95	74.60
WT1	11.43	1.33	1.28	1.60	75.64
WT2	11.45	1.26	1.59	1.78	76.51
WT3	9.34	1.20	2.11	2.11	77.53
WT4	7.11	1.12	2.20	2.15	79.62

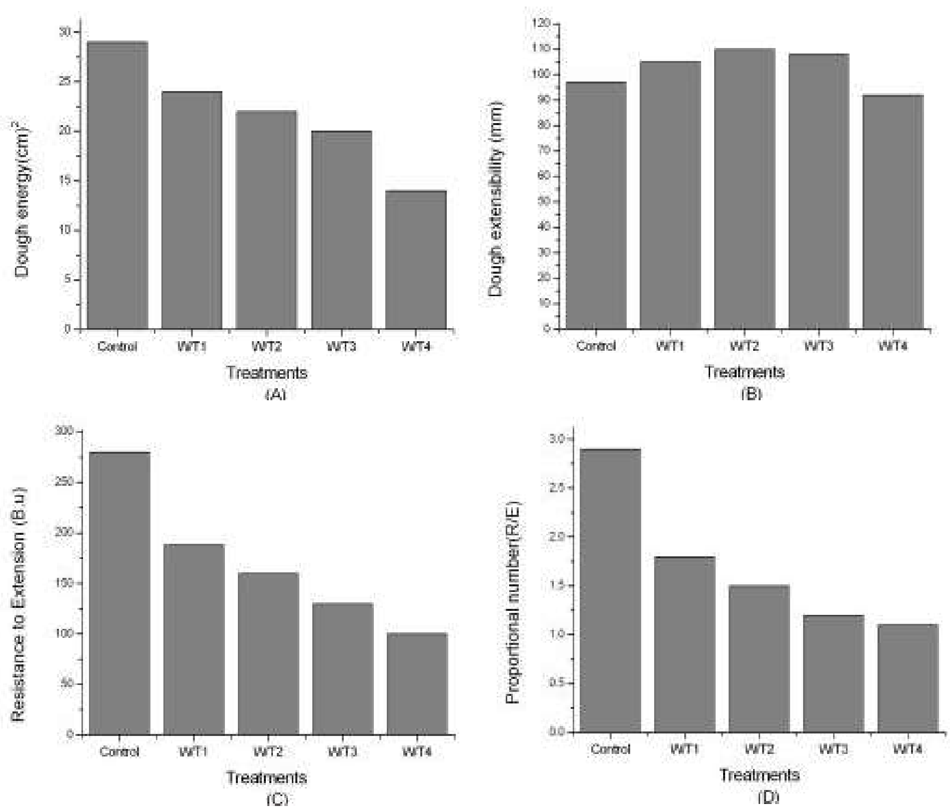

Fig. 2: Extensograph parameters of the control and wheat taro flour blends, where A, dough energy; B, dough extensibility ; C, resistance to extension and D, proportional number

Chemical Composition: Table 4 shows that the increase of substitution ratio of wheat flour with taro flour resulted in decreasing of crude protein and ether extract of the bread samples, while the other components increased with increasing the level of taro flour in the blend since, crude fiber increased from 1.15 to 2.20, ash increased from 0.95 to 2.15 and total carbohydrates increased from 74.60 to 79.62 % for the control and WT4 samples respectively.

DISCUSSION

The incorporation of novel sources (as taro flour) in cereal products is a recent trend to meet the shortage of wheat flour production, decrease the import of wheat which increase the cost of cereal products and also improve using of the local incorporated sources in value added products.

Farinograph properties which show the amount of water required to form the dough and the dough properties showed that increased substitution level of wheat flour with taro flour mainly increased the water absorption and dough weakening, but decreased the mixing time and dough stability which was in agreement with the previous foundation [12,13].

Extensograph parameters of the control and wheat taro flour blends (WT) showed that dough energy, the resistance to extension and the proportional number decreased with the increasing the taro flour level in the flour blends, while the dough extensibility increased in the first three blends (WT1, WT2 and WT3) which may be attributed to the mucus nature of the taro flour.

The organoleptic properties showed that the bread samples which made of blends containing up to 10 % taro flour had organoleptic properties similar to that of control and coincided with Njintang *et al.* [12] who suggested that in order to guarantee the quality of bread made from wheat–taro composite the level of taro addition should not exceed 10 %.

Regarding chemical composition of the wheat taro composite bread samples, the increased of the taro flour level resulted in decreasing in the crude protein, ether extract while the other component increased owing to the chemical composition of taro flour [13,14,15].

It could be concluded that the substitution of wheat flour with taro flour in bread making with substitution level up to 10 % did not adversely affect the quality properties of the bread and produce bread similar to that produced from wheat flour in the rheological and organoleptic properties.

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