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SHORT COMMUNICATION

Effect of incorporation of chicken blood plasma on physico-chemical properties of cakes

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Abstract Level of inclusion of chicken blood plasma (CBP) in the preparation of cakes was assessed in respect of certain physico-chemical quality traits. The cakes were prepared with and without added flavour. In each group, seven cakes were prepared from 0 (control) to 60% level of inclusion of CBP with 10% interval. The cakes at 40% level of incorporation of CBP recorded highest visual grades for colour and consistency. There was gradual rise in cake volume up to 40% level and on further increase in level of inclusion of CBP resulted into subsequent fall in cake volumes. The pH of cakes did not differ significantly up to 20% level but it increased beyond 20%. The moisture, total ash and crude protein contents of cakes exhibited an increasing trend from 0 to 60% level of inclusion of CBP. The ether extract of cakes showed a gradual decrease at increased level of inclusion of CBP. There was no significant effect of flavour for all the parameters studied. Based on the overall results, it may be concluded that CBP could be successfully used up to 30% level of inclusion for value addition in egg products.

Keywords Chicken blood plasma · Cakes · Physico-chemical properties

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Indian agriculture contributes 28% to GDP, of which 17% is shared by poultry. Rapid strides in commercial poultry production over the past 3 decades have led to emergence of India as the 4th largest egg (46 billion) and 5th largest broiler (2 billion) producer in the world (Singh 2007). Indian Council of Medical Research has recommended consumption of 180 eggs and 11 kg poultry meat per annum for an average Indian against the present availability of 42 eggs and 1.6 kg meat respectively. However, poultry industry in its processing sector in respect of production of value-added products has not kept pace with remarkable progress made on the production front and is still in its infancy.

Utilization of animal by-products is one of the vital aspects which has not yet received due attention in developing countries like India. At present most of the by-products of animal origin is going waste in India. The utilization of animal by-products arising from commercial slaughter houses and poultry processing units generates scope for wide variety of materials for further processing. These products include foods suitable for humans like liver, fat, blood, gelatin and sausage casing. The utilization of poultry by-products is one of the possibilities by which poultry processing units may improve their economy. It is therefore worth trying to utilize the by-product like blood for some useful purposes.

The need for ever increasing volume of nutritionally balanced food for an expanding population forces the scientists to think and evolve new ways and means for the production of food from unconventional sources like food processing by-products (Dubbah 1970; Bellamy 1983). Blood is one of the major slaughter house by-products. It is also the major potential source of proteins. The use of protein fractions isolated from blood was suggested as source of high quality dietary protein (Tybor et al. 1975;

Table 1 Effect of addition of chicken blood plasma on visual grades for colour and consistency of cakes with (A) and without (B) flavour

	Level of inclusion of CBP on % basis													
	0		10		20		30		40		50		60	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Visual grades for colour[a]	2^+	2^+	3^+	3^+	4^+	3^+	4^+	4^+	4^+	4^+	2^+	3^+	1^+	1^+
Consistency[b] (*n*=5)	2^+	2^+	3^+	3^+	3^+	3^+	3^+	3^+	4^+	4^+	2^+	2^+	1^+	1^+

[a] Yellow (4^+), Faint yellow (3^+), Creamy (2^+), Pale (1^+)

[b] Very good (4^+), Good (3^+), Moderate (2^+), Poor (1^+)

Shahidi et al. 1984). Chicken slaughter yields about 40 ml of blood/kg of live weight. Blood contains 60–70% plasma and 20–40% red blood corpuscle (Gracey 1986). The plasma contains 4.0–5.2% protein (Reece 2005). It has been estimated that the amount of protein currently discarded or merely downgraded to animal feed or fertilizer may equivalent to one eighths of slaughtered animals (Lawrie 1985). The present study has, therefore been undertaken to study the effect of utilization of chicken blood plasma (CBP) on physico-chemical properties of egg product.

Blood from healthy chickens was collected hygienically. Anticoagulant (sodium citrate) was added at the rate of 0.5% (Del Rio De Rays et al. 1980) to the blood at the time of collection. Blood was centrifuged at 3,000 rpm for 30 min to separate plasma and separated plasma was stored in the refrigerator at 4 °C for further use. The stored plasma was utilized at 0, 10, 20, 30, 40, 50, and 60% levels of inclusion for preparation of pound cakes within 5 days from the date of collection.

Preparation of products For the preparation of cakes the basic recipe consisted of 23.7% wheat flour, 16.6% emulsified shortening, 28.5% sugar, 0.6% salt, 1.4% nonfat milk solid, 1.4% invert sugar, 10.7% water, 16.6% whole egg and 0.3% mango flavour ('Vesco' Kolkata, India) (Tressler and Sultan 1975).

Cakes Refined soybean oil was used as shortening in cakes. In each group of cakes (A: with flavour and B: without flavour) formulations were made out of which one was control (without inclusion of CBP) and others were with 10, 20, 30, 40, 50 and 60% levels of inclusion of CBP.

Cooking method used was conventional commercial oven. The temperature and time of cooking was 149 °C for 45 min. Five batches of cakes from each group were made.

Visual grades for colour of cake were determined by Roche colour fan. Accordingly 4 visual grades were used as Yellow (4^+), Faint yellow (3^+), Creamy (2^+) and Pale (1^+). The average scores were rounded off to express in round

Table 2 Effect of addition of chicken blood plasma on physico-chemical properties of cakes with (A) and without (B) flavour

		Level of inclusion of CBP on % basis						
		0	10	20	30	40	50	60
Volume, cc	A	58.2^a±0.49	68.4^c±0.40	76.8^d±0.49	83.0^e±0.45	87.4^f±0.60	82.0^e±0.80	61.6^b±0.40
	B	59.8^a±1.07	67.8^c±0.66	76.0^d±0.63	82.0^e±0.63	89.2^e±0.58	83.6^d±0.87	62.2^b±0.58
pH	A	6.2^a±0.07	6.1^a±0.04	6.1^a±0.02	6.2^{ab}±0.06	6.3^b±0.05	6.4^b±0.10	6.6^e±0.09
	B	6.0^a±0.05	6.1^a±0.04	6.2^{ab}±0.04	6.3^{bc}±0.07	6.3^{bc}±0.07	6.4^{cd}±0.04	6.6^d±0.08
Moisture, %	A	12.4^a±0.20	13.1^b±0.10	13.1^b±0.04	13.7^c±0.08	14.0^{cd} ±0.04	14.2^d±0.05	14.7^e±0.08
	B	12.6^a±0.28	13.0^b±0.08	13.1^b±0.04	13.7^c±0.07	13.9^c±0.07	14.3^d±0.05	14.8^e±0.06
Ash, %	A	2.1^a±0.01	2.1^{ab}±0.01	2.1^{bc}±0.003	2.1^{cd}±0.003	2.1^{cd}±0.002	2.1^d±0.002	2.1^d±0.002
	B	2.1^a±0.002	2.1^b±0.003	2.1^b±0.002	2.1^{bc}±0.002	2.1^{cd}±0.001	2.1^{de}±0.002	2.1^e±0.001
Crude protein, %	A	4.7^a±0.04	5.4^b±0.02	6.2^c±0.02	6.8^d±0.02	7.5^e±0.025	8.2^f±0.022	8.9^g±0.02
	B	4.6^a±0.02	5.4^b±0.05	6.2^c±0.01	6.8^d±0.02	7.5^e±0.05	8.2^f±0.01	8.8^g±0.03
Ether extract, %	A	17.2^g±0.08	16.2^f±0.02	14.3^e±0.03	13.7^d±0.03	12.7^c±0.04	11.9^b±0.01	11.2^a±0.01
	B	17.1^g±0.08	16.2^f±0.01	14.4^e±0.02	13.7^d±0.01	12.7^c±0.03	11.9^b±0.01	11.2^a±0.05

(n=7), Means in a row bearing common superscripts and subscripts do not differ significantly (p<0.01) figure. Consistency of the cake was determined by 10 members of sensory evaluation panel on the basis of tenderness and texture of the cake. Accordingly 4 grades were made as Very good (4^+), Good (3^+), Moderate (2^+) and Poor (1^+). The average scores were rounded off to express in round figure. The volume of cake was measured by mustard seed displacement method as per Reddy et al. (1969). The mustard seeds were dropped from a constant height on the top of the cake, leveled by a scale and measured in a graduated cylinder.

$$\text{The volume of cake in ml} = \text{Volume of seeds in loaf pan without cake} - \text{Volume of seeds in loaf pan with cake.}$$

The pH of samples was determined as per the method of Pippen et al. (1965). Moisture, total ash, crude protein and ether extract of cakes were determined as per AOAC (2000).

The data were subjected to statistical analysis as per the methods described by Snedecor and Cochran (1989).

The highest scores for colour of cakes with and without flavour were recorded at 40 and 30% level of inclusion of CBP respectively (Table 1). By using bovine plasma protein isolates, Khan et al. (1979) prepared angel food cakes and found better acceptability for colour of cakes with 30% bovine blood plasma and 70% inclusion of egg white. Increased level of blood plasma protein isolate resulted in unacceptable colour in angel food cakes. In the present study it was found that CBP could successfully be used up to 30 to 40% to maintain acceptable colour in cakes. Consistency of cakes with and without flavour was highest at 40%, followed by 30 and 20% of CBP. Lower grades for consistency at 50 to 60% levels of CBP may be due to higher moisture content of cakes.

Volume of cakes with and without flavour was highest at 40% level of inclusion of CBP (Table 2). On further increase of CBP gradual decrease in cake volume was observed. This might be due to surface collapse of the cells of the cakes as a result of excessive water content of cake batter (Martin and Tsen 1981). Negative correlation between moisture content and cake volume was also observed by Wilson and Donelson (1963). Cakes with and without flavour exhibited gradual rise in pH at and after 30% level of inclusion of CBP. There was no significant effect of flavour on pH of cakes. Blood plasma if stored for longer periods may result in breakdown of amino acid linkage of plasma protein. This breakdown results in liberation of free ammonia which might increase in alkalinity of blood plasma. The increasing trend in pH might be due to addition of plasma which was stored for more than a day.

The moisture content of cakes with and without flavour did not differ significantly at all levels of inclusion of CBP. Blood plasma contains 91% water (Deng-Cheng and Ockerman 2005). It was observed that with the increase in the level of inclusion of CBP, the moisture content in both the types of cakes also increased. The reason might be due to excess water content of batter as a result of addition of blood plasma.

There was an increasing trend in total ash content with gradual increase in the level of inclusion of CBP with and without flavour. The mineral content of CBP may be responsible for the increase in total ash content of cakes. The total ash content of cakes was not affected significantly due to addition of flavour.

The total crude protein of cakes with and without flavour at different levels of inclusion of CBP was highest (8.9 and 8.7%) at 60% level of inclusion and lowest (4.7 and 4.6%) at 0% level. As the level of CBP increased, there was gradual increase of crude protein content in both the groups of cakes. The findings of Del Rio De Rays et al. (1980) in CBP and Khan et al. (1979) in bovine blood plasma also support the present finding. Ether extract of cakes with and without flavour were highest at 0% and lowest at 60% level of CBP and no significant differences were recorded between the cakes. However, significant ($p<0.01$) differences were observed in ether extract content when comparison was made among the levels of incorporation of CBP in a particular flavour group. The major sources of fat in both types of cakes were refined oil, egg yolk and wheat flour. In comparison with the other ingredients used for preparation of cakes, CBP contained negligible amount of fat. Thus at increasing level of CBP, ether extract content decreased gradually.

Based on the present study, it is concluded that CBP can successfully be included up to 30% level in cakes for value addition. Cakes having higher proteins and less fat could be produced by utilization of CBP. The CBP which is otherwise considered as waste, can be converted to wealth as value adder to human food products like cakes.

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