COMPARATIVE EFFECT OF WHOLE EGG LIQUID AND SKIM MILK POWDER AS BINDER FOR PORK PATTIES*

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The comparative effect of whole egg liquid and skim milk powder on physico-chemical and sensory characteristics of pork patties were studied. Pork patties were prepared by using whole egg liquid as a binder at 5, 7 and 10% levels of inclusion and skim milk powder as a binder at 1.5, 3 and 5% levels of inclusion. Among the various levels of inclusions the 5% level of whole egg liquid and the 3% level of skim milk powder were found to be best suited levels, respectively. Then the better binder among the two were analysed. The emulsion stability and the product yield were significantly (P<0.01) higher in patties incorporating whole egg liquid. The moisture and the protein contents were significantly (P<0.01) higher in the pork patties by incorporating skim milk powder. Both the binders has evoked a marked enhancement in sensory attributes. Based upon physico-chemical and sensory attributes, the whole egg liquid was considered better than the skim milk powder as a suitable binder.

Key words: Pork patties, whole egg liquid, skim milk powder, emulsion stability, product yield, shear force value, sensory evaluation

Pig meat production in India is 497.07 thousand tones, which is 7.4 % of the total meat production (FAO 2005). Pork is rich in thiamine; it is also a source of riboflavin, niacin and excellent source of some of the mineral elements, which are present in highly bioavailable form. Rapid expansion of fast food markets has prompted the meat processors to seek methods for better utilisation of carcass trimmings and provide products, which are convenient and stable during storage. For improving the functional properties and maintaining the nutritional value of low value meat, binders are used. In the present study animal protein binders like whole egg liquid and skim milk powder were incorporated in the preparation of pork patties, which are cheaper and locally available. Hence, the present study was undertaken to study the effect of binders on physico-chemical and organoleptic properties of the pork patties and to develop a suitable formulation for pork patties incorporating less valuable parts of pig carcasses using whole egg liquid and skim milk powder as binders.

MATERIALS AND METHODS

In this research work a total of three experiments were conducted on the preparation of pork patties. In the first two experiments, pork patties were prepared by using whole egg liquid as a binder at 5, 7 and 10 per cent levels of inclusion and by using skim milk powder as a binder at 1.5, 3 and 5 per cent levels of inclusion. These experiments were replicated 6 times in each levels of inclusion. Then the optimum levels of inclusion of the above two binders were arrived. In the third experiment pork patties were prepared with the optimum levels of

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whole egg liquid and skim milk powder as binder as per the above findings to find out the better binder among the two. The samples prepared were subjected to analysis of physico-chemical parameters like emulsion pH, product pH, emulsion stability, product yield, and product shrinkage; shear force value and sensory evaluation by panelists to derive the better binder.

Pork was obtained by hot deboning of Large White Yorkshire pigs slaughtered in the Department of Meat Science and Technology, Madras Veterinary College, Chennai. The back fat was collected from the back region. The meat obtained from pig head, cheek, heart and tongue were utilised for the preparation of emulsion. For every 1000g of meat mixture lean meat; low value meat and fat were added at the rate of 500g, 300g and 200g respectively. For every 1000g of meat mixture 17.5g of salt, 120ppm of sodium nitrite, 3g of sodium tripolyphosphate were used as curing agents. Dry cure method was followed. The following spices in percentage w/w were used in this study. Coriander- 20, Aniseed – 14, Black pepper - 12.8, Capsicum – 14, Cumin – 10, Cinnamon – 4, Cloves – 4, Turmeric – 4, Cardamom – 3, Ginger Powder – 10, *Khus khus* - 2.8, Anana Flowers - 0.6, Mace - 0.4, Cassia - 0.2 and Nutmeg - 0.2. The above-mentioned ingredients were ground and sieved. The finely ground powder was stored for subsequent use. For every 1000g of meat mixture 13g of spice mixture was used. Condiments used in the study were onion and garlic in the ratio of 3:1 and were ground to the consistency of fine paste. For every 1000g of meat mixture 30g of condiment mixture was used. Control pork patties were formulated based on the proportions of lean meat @ 50%, low value meat @ 30% (head and cheek meat - 22.6%, heart - 3.8%, tongue meat - 3.6%), and fat @ 20% obtained from back region of pig carcasses. To the above control formulation whole egg liquid at 5, 7 and 10 per cent were added and processed as mentioned below. Skim milk powder at 1.5, 3 and 5 per cent levels of inclusion were added to the control formulation and processed as reported below.

The lean meat, low value meat and fat were chilled to 4°C by keeping in refrigerator for over night. Thawed lean meat and fat were minced separately through a 4mm plate in meat mincer. By using same plate, low value meat was also minced. To the minced meat constituents, salt, sodium tripolyphosphate and sodium nitrite were added along with 30% of slushed ice in bowl chopper and chopped for one minute. Either whole egg liquid or skim milk powder were added as binder and chopped for one minute. Then fat was added with 30% of slushed ice and chopped for one minute. After that condiment mix, spice mix and remaining 40% of slushed ice were added and chopped for one minute. Finally maida was added and chopped for one minute. Patties (70g each) were formed from the emulsions using a mould having inner diameter of 7.3 cm and height of 1.5 cm and placed on the vegetable oil smeared cooking trays.

Patties were cooked in a preheated hot air oven at 180°C for 25 minutes. After first 15 minutes, the patties were turned upside down and cooked for another 10 minutes so as to attain the internal temperature of 73 ?± 2°C.

Samples from each batch were analysed on the same day for the following parameters in order to determine the optimum level of inclusion of these two binders.

The assessment of pH of emulsion and product were done by the use of a digital pH meter (Bouton *et al.* 1971). Emulsion stability was estimated by the method outlined by Baliga and Madaiah (1971) and modified by Kondaiah *et al.* (1984). Individual weight of patties before and after cooking was recorded for determining the product yield. The diameter of the cooked patties was recorded to estimate the product shrinkage (EL-Magoli *et al.* 1996). Each experiment was repeated six times using six different patties.

The shear force values of cooked patties were recorded as per method of Berry and Stiffler

(1981) using Warner Bratzler Shear Press. Representative samples of cooked patties were served to panelists for sensory evaluation by using a nine point hedonic scale to assess the appearance and colour, flavour, texture, juiciness and overall acceptability. Moisture, fat (ether extractable), protein and ash content of patties were determined according to standard (AOAC 1995) procedures.

After assessing the optimum level of inclusion of two binders, patties were processed to compare and find out the better binder among whole liquid egg and skim milk powder. Analyses were done for physico-chemical parameters like emulsion pH, product pH, emulsion stability, product yield, product shrinkage, shear force value, TBARS and the sensory evaluation by panelists on the day of processing. The data obtained in this study were analysed by randomized block design using two-way analysis of variance as outlined by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

The Effect of Various Levels of Whole Egg Liquid on Physico-Chemical and Sensory Characteristics of Pork Patties

The mean ± SE values along with analysis of variance of various parameters studied on three different levels of inclusion of whole egg liquid are presented in Table 1.

The analysis of variance in product yield revealed that there was a significant ($P<0.01$) difference noticed between control and the treatments. The emulsion stability was also increasing progressively with increasing levels of inclusion and was the highest in 10% and the lowest in control, which is in agreement with the observations reported by Pati *et al.* 1992. There was highly significant ($P<0.01$) improvement in product yield of pork patty incorporated with whole egg liquid when compared to control. The incorporation of whole egg liquid improved the product yield by retaining more water and fat during cooking (Padda *et al.* 1988). Product shrinkage was highest at control and lowest at 5% level of inclusion, similar observations was reported by Manish Kumar and Sharma 2003. There was a significant ($P<0.01$) difference noticed between control and treatments. Incorporation of whole egg liquid decreased the shear force value upto 7% level. However, the shear force values markedly decreased in all the treatments over the control. The results of the present study were in agreement with Gupta *et al.* (1993).

All the patties including control were rated as good. The appearance, flavour, juiciness, texture and overall acceptability scores were highest at 5% level, whereas, control and 10% level of inclusion recorded the lowest. These findings are in congruence with the observations of Hussain *et al.* (1988), Padda *et al.* (1988), Kalaikannan *et al* (2007) and Gupta *et al.* (1993). Incorporation of whole egg liquid at 5% level had highest score when compared to other two levels of inclusion.

Based upon emulsion stability, product yield and shear force value, incorporation of whole egg liquid upto 7% showed a positive trend whereas whole egg liquid as in 5% level of inclusion, sensory evaluation scores were significantly higher. Hence 5% level of inclusion of whole egg liquid was considered to be optimum for the improvement of patties made from low value meat.

Effect of Various Levels of Skim Milk Powder on Physico- Chemical and Sensory Characteristics of Pork Patties

The mean ± SE values of various parameters of patties with three different levels of inclusion of skim milk powder are presented in Table 2.

The analysis of variance of emulsion stability revealed that there was significant ($P<0.01$) difference existing between control and 5% level of inclusion. The emulsion stability of 5% skim milk powder incorporated emulsion was higher (Rao *et*

al. 1999). There was a significant (P<0.01) difference noticed between control and 3% level of inclusion. The product yield was highest at 5% level of inclusion. Addition of skim milk powder improved the product yield because of higher solubility, water and fat binding characteristics of skim milk powder (Sen *et al.* 1994). Product shrinkage was highest at control and lowest at 5% level of inclusion. This was in accordance with Manish Kumar and Sharma (2003). Though it was marginally higher in the treatment groups and lower in the control this was in accordance with Sen *et al.* (1994). All the patties including control were rated as good.

The appearance, flavour, juiciness, texture and overall acceptability scores were the highest at 3% level of inclusion. The same results were reported by Hung and Zayas (1992), Sen *et al.* (1994) Bhoyar *et al.* (1998) and Manish Kumar and Sharma (2003).

Based upon emulsion stability, product yield, and product shrinkage, incorporation of skim milk powder upto 5% showed a positive trend whereas as in 3% level of inclusion sensory evaluation scores was significantly higher. Hence 3% level of inclusion of skim milk powder was considered to be optimum for the improvement of patties made from low value meat.

Effect of Whole Egg Liquid and Skim Milk Powder on Physico- Chemical and Sensory Characteristics of Pork Patties

The mean ± SE values of physico-chemical and sensory characteristics of patties with two different binders at their optimum levels (whole egg liquid 5% and skim milk powder 3%) are presented in Table 3.

Whole egg liquid incorporated emulsion had significant (P<0.01) improvement in the emulsion stability over the control. The emulsion stability of the whole egg liquid incorporated emulsion was highest followed by skim milk powder incorporated emulsion and control. Whole egg liquid incorporated emulsion had significant (P<0.01) improvement in the product yield over the control. Product shrinkage was least in whole egg liquid treated patties followed by skim milk powder treated ones. Higher product yield resulted in lower product shrinkage (El Magoli *et al.*(1996). Significant difference (P<0.01) was noticed in shear force value between control and treated samples. Shear force value was also found to be highest in control by Manish Kumar and Sharma (2003).

Significant difference (P<0.01) was noticed in moisture content between control and treated samples. Similar result was reported by Gupta *et al.* (1993) and Rao *et al.* (1999). Significant (P<0.05) difference in protein content was noticed between whole egg liquid and skim milk powder treated patties. Moisture and protein content was highest in skim milk powder treated patties and least in control. Fat and ash content of patties slightly increased in treatments over the control.

Significant (P<0.01) difference in flavour score was noticed between control and treated patties. This was in congruence with Gupta *et al.* (1993) and Manish Kumar and Sharma (2003). The flavour, juiciness, texture and overall acceptability scores of the whole egg liquid added product were the highest.

It could be concluded that whole egg liquid incorporated patties were better in terms of physico-chemical than skim milk powder incorporated patties. By incorporating the low value meat at 30% for the preparation of pork patties the product was found to be well acceptable and the under utilised low value meat was also value added.

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Table 1

Mean ± SE Values for the Effect of Various Levels of Whole Egg Liquid on Physico-chemical and Sensory Characteristics of Pork Patties

Parameters	n	Control	Levels of Whole Egg Liquid		
			5%	7%	10%
Emulsion pH	6	6.08 ± 0.02	6.11 ± 0.03	6.13 ± 0.03	6.15 ± 0.03
Product pH	6	6.23 ± 0.02	6.27 ± 0.02	6.29 ± 0.02	6.33 ± 0.02
Emulsion stability %	6	85.64^{a} ± 0.29	90.20^{b} ± 0.20	91.20^{b} ± 0.15	92.44^{c} ± 0.30
Product yield %	42	83.19^{a} ± 0.25	85.78^{c} ± 0.22	86.23^{c} ± 0.21	84.46^{b} ± 0.31
Product shrinkage %	30	10.64 ± 0.19	10.76 ± 0.09	10.91 ± 0.12	11.07 ± 0.13
Shear Force (kg/cm^2)	30	0.631^{c} ± 0.01	0.548^{b} ± 0.01	0.523^{a} ± 0.01	0.533^{ab} ± 0.01
Sensory Characteristics					
Appearance	30	7.20 ± 0.12	7.33 ± 0.09	7.26 ± 0.11	7.2 ± 0.12
Flavour	30	7.20^{a} ± 0.13	7.4^{b} ± 0.10	6.8^{a} ± 0.14	6.76^{a} ± 0.14
Juiciness	30	6.93^{x} ± 0.13	7.4^{y} ± 0.10	7.2^{xy} ± 0.12	7.06^{x} ± 0.10
Texture	30	6.90^{x} ± 0.12	7.33^{y} ± 0.09	7.03^{xy} ± 0.12	6.93^{x} ± 0.12
Overall acceptability	30	6.90^{x} ± 0.12	7.33^{y} ± 0.09	7.26^{y} ± 0.10	7.1^{xy} ± 0.13

Means bearing the same superscripts do not differ significantly (P>0.05)

Table 2

Mean ± SE Values for the Effect of Various Levels of Skim Milk Powder on Physico - Chemical and Sensory Characteristics of Pork Patties

Parameters	n	Control	Levels of Skim Milk Powder		
			1.5%	3%	5%
Emulsion pH	6	6.05 ± 0.01	6.07 ± 0.02	6.10 ± 0.02	6.13 ± 0.02
Product pH	6	6.27 ± 0.01	6.3 ± 0.01	6.32 ± 0.01	6.35 ± 0.02
Emulsion stability %	6	82.70^{a} ± 0.50	85.86^{b} ± 0.08	89.66^{c} ± 0.34	90.07^{c} ± 0.2
Product yield %	42	81.86^{a} ± 0.30	82.55^{a} ± 0.37	85.17^{b} ± 0.23	85.35^{b} ± 0.21
Product shrinkage %	30	11.17 ± 0.13	10.9 ± 0.20	10.87 ± 0.13	10.72 ± 0.11
Shear Force (kg/cm^2)	30	0.683 ± 0.01	0.686 ± 0.01	0.69 ± 0.01	0.695 ± 0.01
Sensory characteristics					
Appearance	30	7.16 ± 0.12	7.16 ± 0.12	7.20 ± 0.12	7.1 ± 0.13
Flavour	30	6.76^{x} ± 0.12	7.13^{y} ± 0.14	7.23^{y} ± 0.11	7.16^{y} ± 0.12
Texture	30	6.66^{x} ± 0.09	7.03^{y} ± 0.12	7.16^{y} ± 0.11	7.00^{y} ± 0.12
Juiciness	30	6.70^{a} ± 0.09	6.76^{ab} ± 0.10	7.16^{b} ± 0.11	7.03^{b} ± 0.11
Overall acceptability	30	6.70^{x} ± 0.10	7.03^{xy} ± 0.13	7.26^{y} ± 0.11	7.06^{y} ± 0.13

Table 3

Mean ± SE Values for the Effect of Whole Egg Liquid and Skim Milk Powder on Physico Chemical and Sensory Characteristics of Pork Patties

Parameter	n	Control	Whole Egg Liquid (WEL)	Skim Milk Powder (SMP)
Emulsion pH	6	6.11 ± 0.02	6.15 ± 0.02	6.14 ± 0.02
Product pH	6	6.15 ± 0.01	6.18 ± 0.02	6.18 ± 0.02
Emulsion stability (%)	6	89.97^{a} ± 0.22	91.09^{b} ± 0.22	90.85^{ab} ± 0.21
Product yield %	42	82.26^{a} ± 0.22	85.3^{c} ± 0.21	84.29^{b} ± 0.21
Product shrinkage %	30	11.14 ± 0.07	10.70 ± 0.14	10.92 ± 0.10
Shear force (kg/cm^2)	30	0.625^{b} ± 0.01	0.583^{a} ± 0.01	0.590^{a} ± 0.01
Moisture (%)	6	54.47^{a} ± 0.29	56.25^{b} ± 0.11	56.36^{b} ± 0.2
Protein (%)	6	17.10^{x} ± 0.04	17.06^{x} ± 0.15	17.54^{y} ± 0.03
Fat (%)	6	21.98 ± 0.20	22.63 ± 0.20	22.40 ± 0.19
Ash (%)	6	2.72 ± 0.03	2.83 ± 0.02	2.77 ± 0.03
Sensory characteristics				
Appearance	30	7.20 ± 0.12	7.26 ± 0.11	7.2 ± 0.12
Flavour	30	6.90^{a} ± 0.11	7.46^{b} ± 0.09	7.3^{b} ± 0.09
Texture	30	6.76^{x} ± 0.11	7.33^{y} ± 0.11	7.13^{xy} ± 0.11
Juiciness	30	6.86^{a} ± 0.09	7.23^{b} ± 0.10	7.10^{ab} ± 0.10
Over acceptability	30	6.96^{x} ± 0.12	7.36^{y} ± 0.11	7.33^{y} ± 0.09

Means bearing the same superscripts do not differ significantly (P>0.05)