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ORIGINAL ARTICLE

The Effect of Higher Levels of Egg Albumen as Binder in Beef Burger

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Abstract

The study determined the suitability, binding effect and yield of beef burger formulated with egg albumen as a binder at higher inclusion levels. The four different levels of inclusion of the egg albumen per kilogram of meat were 0, 200, 250 and 300g which corresponded to each treatment T1(control), T2 (18%), T3 (22.5%) and T4 (27%), respectively. Equal amount of spices were added to the meat (g/kg). The burgers were manually moulded using a cylindrical tube to obtain uniform sizes. They were vacuum-packed in transparent packaging bags and stored at 4°c for laboratory and sensory analysis. Egg albumen had no effect (P>0.05) on the cooking loss and lateral shrinkage of the products, but the doming was significantly different (P<0.05). Doming was higher in T3 and T4 than T1 and T2. There were no significant differences (P>0.05) in the sensory parameters of the beef burgers except for cohesiveness. Beef burgers with egg albumen were firmer than the control beef burger. The egg albumen significantly (P<0.05) reduced the fat content of T3 and T4. The protein content of the burgers was not significantly different (P>0.05) between the control and test beef burgers. The pH and moisture contents of the control beef burgers were significantly lower (P<0.05) than the test beef burgers.

Keywords: Beef Burger, Binder, Egg Albumen, Yield.

1. Introduction

Meat and meat products are enjoyed and cherished by many people. Meat is the flesh of a slaughtered animal that is eaten as food and this may include skeletal muscle, fats and other tissues (Lawrie and Ledward, 2006). In the meat processing industry the inclusion of non-meat ingredients in meat products are considered an important strategy for reducing overall production costs, while maintaining nutritional and sensory qualities of the end products (McWatters, 1990; Ahmad *et al.*, 2015). Meat is a primary source of quality protein required by man for growth and repair of worn out tissues (Lawrie and Ledward, 2006). Meat and meat products are appreciated as food by most people in the world and play very important role in our nutrition, as contributors of high-quality protein and other important nutrients (Simonsen *et al.*, 1988; Adzitey, 2012). Different meat products such as burgers, meatballs and sausages have been developed using local spices, food resources and meat from pork, beef, duck and quail to add value to them (FAO, 1999; Teye *et al.*, 2006; McAfee *et al.*, 2010; Abd-elhak *et al.*, 2014; Ahmad and Nawab, 2014; Adu-Adjei *et al.*, 2014; Adzitey *et al.*,2014; Adzitey *et al.*, 2015; Amanfo *et al.*, 2015; Haslia *et al.*, 2015a-b; Kumari *et al.*, 2015; Santana *et al.*, 2015; Sharma *et al.*, 2015; Teye *et al.*, 2015a-b).

Value is added to meat and meat products for comfort and convenience of consumers and for ease of transportation from the point of production to the table for consumption. Non-meat ingredients may be added to meat products in smaller quantities for taste and flavour impartation, binding and increment of quantity (FAO, 2007; Mendiratta *et al.*, 2013). All meat and non-meat ingredients are used in the fresh state but some are slightly processed during their extraction with the addition of spice (FAO, 2010). The use of polyphosphates in comminuted meat products is however, impeded by some setbacks. In Ghana, it is scarce and when available it is expensive to acquire (Teye, 2010). Also, being a chemical additive some consumers have fears that it may leave residues, which could be harmful when such products are consumed over a long period (McCarty, 2004; Smith and Young, 2007). Therefore, the need to find non-chemical ingredients that are readily available and can serve as substitutes for polyphosphates in comminuted meat

products (Means and Schmidt, 1987). A potential ingredient for such application is egg albumen.

Siegel *et al*. (1979) demonstrated that egg albumen was a good binder for meat pieces. In Ghana, much work has not been done on egg as a binder in burger/sausage. Burgers without binders become flaky after cooking. The challenge, however, is the cohesiveness. Adzitey *et al*. (2014) demonstrated that whole egg did not affect the cohesiveness of beef burger at lower inclusion levels of 5, 10 and 15%. Therefore, the present study is to evaluate the effect of egg albumen at higher inclusion levels in beef burger.

2. Materials and Methods

2.1 Location

Preparation of meat products and sensory evaluation of the products were done at the University for Development Studies (UDS), Meat Unit and the proximate analysis was done at the Spanish Laboratory of UDS, Nyankpala, in the Northern region of Ghana.

2.2 Processing of Beef Burger

Four kilograms of lean beef was used for the experiment. The meat was thawed at 1°C for 3hours and minced using the table top mincer (Teller Ramon, Spain) through a 5mm sieve. The minced beef was divided into four treatments, one kilogram each. Each kilogram of minced beef was mixed with 1.0g black pepper, 1.0g white pepper, 0.5g red pepper, 2.0g mixed spice (Adobo®) and 15g curing salt. The spices were measured into one container and mixed thoroughly before adding it to the minced beef. One hundred (100) ml of water was added to each treatment and mixed until the desired consistency was obtained. The four experimental treatments were formulated with 0g, 200g, 250g and 300g of raw egg albumen per kilogram of beef which corresponded to the products T1(0%), T2(18%), T3(22.5%) and T4(27%), respectively. The mixed meat was then spread in trays and moulded into circular shapes. The products were stored in deep freezed condition for sensory evaluation.

2.3 Selection of Taste Panel

Fifteen (15) panelists, aged between 20 and 35 years were randomly selected and trained according to the British method of sensory evaluation to evaluate the product (BSI, 1993).

2.4 Preparation of Products for Sensory Analysis

The frozen burgers were thawed for 30 minutes, weighed and grilled to a core temperature of 70°C for 15 minutes by the use of griddle oven (Turbofan, Blue Seal, UK). The products were then sliced into pieces of equal sizes of 1.3cm thickness each and wrapped in a coded aluminium foil to keep it warm.

2.5 Sensory Evaluation

The sensory evaluation was conducted using a 5-point category scale as shown in Table 1. Each panelist was served with the test product in addition to a piece of bread to act as a neutralizer between tests. Panelists were asked to indicate the eating qualities of the various samples with the aid of the 5 - point scale.

2.6 Cooking Loss, Doming, Lateral Shrinkage, and Welling of Products

Cooking loss is the difference in the weight of the product before and after cooking. Doming (thickness) is the rise in height of the product and was determined by measuring the height of the product before and after cooking (Adzitey *et al.*, 2014). Lateral shrinkage is the shrinkage of a product towards a direction, thus a burger which is circular in shape might look oval after cooking and was measured by the diameter of the products at different directions before and after cooking (Adzitey *et al.*, 2014). Welling is the accumulation of fluid in the vacuole of the product and it is determined by observation (Adzitey *et al*., 2014).

2.7 Laboratory Analyses of Products

Analyses to determine the pH, moisture, crude fat (ether extract) and crude protein of the processed products were carried out to establish the nutritive value of the products. Analyses were done according to the method of the International Association of Official Analytical Chemists (AOAC, 1999). Analyses were done in duplicates. All reagents used were of analytical grade. For the determination of pH, 10g beef burger of each treatment was ground with a laboratory mortar and pestle, homogenized with 50ml distilled water, and pH values were measured with a digital pH-meter (CRISON, Basic 20, Spain).

2.8 Statistical Analysis

All data collected was analysed using the General Linear Model (GLM) the Analysis of Variance (ANOVA) of the Genstat Statistical Package, Edition 4.

3. Results and Discussion

3.1 Cooking loss, Doming, Lateral Shrinkage and Welling of the Beef Burgers

There was no significant difference ($P > 0.05$) in the cooking loss and lateral shrinkage of the control and test beef burgers (Table 2). It means that the yield -

Table 1: Five (5) -point scale used for the sensory evaluation.

Attribute	Scale
Texture	1-Very Smooth 2-Smooth 3-Intermediate 4-Rough 5-Very Rough
Taste	1-Very Pleasant 2-Pleasant 3-Intermediate 4-Bitter 5-Sour
Juiciness	1-Very Juicy 2-Juicy 3-Intermediate 4-Dry 5-Very Dry
Colour	1-Brown 2-Light Brown 3-Intermediate 4-Dark 5-Very Dark
Egg flavour	1-Very Strong 2-Strong 3-Intermediate 4-Weak 5-Very Weak
Cohesiveness	1-Very firm 2-Firm 3-Intermediate 4-Loose 5-Very Loose
Overall liking	1-Like Very Much 2-Like 3-Intermediate 4-Dislike 5-Dislike Very Much

and shape of the burgers were not negatively affected by the addition of egg albumen. However, doming was significantly higher (P>0.05) in beef burgers prepared using egg albumin than the control. Thus, beef burgers prepared using egg albumen appeared thicker than the control beef burger. It is possible some consumers will prefer such burgers with the perception that it will be bigger, heavier and perhaps more value for money. Welling was not observed in all the beef burgers. Welling, which is the accumulation of fluids in the burger would have had negative influence on the acceptability of the beef burgers. Therefore, the absence of welling is good for the acceptability of the burgers. Adzitey *et al*. (2014) also did not observe welling in beef burgers prepared using 50g, 100g and 150g of whole chicken egg, which agrees with the current study.

3.2 Sensory Characteristics of the Beef Burgers

The results obtained for the sensory evaluation of the beef burgers are shown in Table 3. From Table 3, there were no significant differences (P>0.05) in the texture, taste, juiciness, colour, egg flavour and overall-liking of the control and test beef burgers. Texture (feel of a substance i.e. smoothness, roughness and softness), taste, juiciness (attribute of meat being delicious and succulent), colour (an important indicator of freshness) and flavour (sensory impression by combining taste, smell and mouth feel) are important meat and meat products attributes that have significant influence on acceptability by consumers. For instance, offensive flavour scare away buyers and consumers tend to reject products that have different colour from what they are accustomed. The present study revealed that the use of egg albumen up to 300g as a binder in beef burger did not have any negative influence on the burgers. Thus, the texture, taste, juiciness, colour, egg flavour and overall-liking of beef burgers prepared using egg albumen will similarly be accepted as the control beef burger.

However, the cohesiveness of beef burgers (T2 and T4) prepared using egg albumen was significantly firmer (P<0.05) than the control beef burger. Cohesiveness is the ability to hold solid and liquid together. Protein coagulates during thermal processing, resulting in the formation of cream-like structures which bind together the batter structural units (Barbut, 1995; Xiong, 1997). Siegel *et al*. (1979) reported that egg albumen coagulates when heated, and therefore served as a good binder for meat pieces when used in reformed meat products. The egg albumen was able to hold the meat pieces together better than the control.

3.3 Crude Protein, Crude Fat, Moisture and pH of Beef Burgers

There was no significant difference (P>0.05) in the crude protein of the beef burgers (Table 4). According to Chen and Lu (1999), egg albumen contains mainly protein and therefore, its addition to the meat products has the advantage of increasing the crude protein contents of the final product. Although the crude protein content of the beef burgers did not differ significantly, beef burgers containing egg albumen were numerically higher. The crude fat, moisture and pH of the beef burgers differed significantly (P<0.05). The crude fat content of the beef burgers prepared using 250g and 300g of egg albumen were lower than the control, which could be due to the absence of the egg yolk. Health conscious individuals are modifying their dietary habits and eating less fat (Miller and Groziak, 1996), therefore the low fat in the product is good health wise. The moisture content of the beef burgers prepared using 250g and 300g of egg albumen were also significantly higher (P<0.05) than the control. Moisture contributes to the tenderness and juiciness of meat products. The pH of the beef burgers

Table 2: Cooking loss, Doming and Lateral Shrinkage of products.

Parameter	T1	T2	T3	T4	S.E.D	P-value
Cooking loss (g)	20.65	22.45	25.00	25.63	2.556	0.257
Doming (cm)	0.00^{c}	0.10^{b}	0.43^{a}	0.47^{a}	0.033	0.001
Lateral shrinkage(cm)	0.47	1.13	0.63	0.40	0.303	0.144

SED = *standard error of difference, Means in the same row with different superscript are significantly different (P < 0.05). T1, T2, T3 and T4 are beef burgers containing 0g egg albumen, 200g egg albumen, 250g egg albumen and 300g egg albumen, respectively.*

Table 3: Sensory characteristics of egg albumen as binder in beef burgers.

Parameter	T1	T2	T3	T4	S.E.D	P-value
Texture	3.47	3.33	3.20	3.0	0.398	0.920
Taste	2.00	1.93	2.13	2.13	0.260	0.828
Juiciness	2.07	1.93	2.00	1.93	0.327	0.972
Colour	2.00	1.87	1.80	2.00	0.259	0.826
Egg flavour	2.13	2.40	2.27	2.80	0.326	0.209
Cohesiveness	4.13^{a}	3.47^{b}	3.93^{ab}	3.33^{b}	0.323	0.051
Overall-liking	2.07	2.20	1.87	2.13	0.280	0.663

SED = standard error of difference, Means in the same row with different superscript are significantly different (P < 0.05). T1, T2, T3 and T4 are beef burgers containing 0g egg albumen, 200g egg albumen, 250g egg albumen and 300g egg albumen, respectively.

Table 4:Crude protein, crude fat, moisture and pH of beef burgers.

Parameters	T1	T2	T3	T4	S.E.D	P-value
Crude Protein	13.09	13.98	13.79	14.00	0.284	0.096
Crude Fat	3.33^{b}	6.08^{a}	1.92^{c}	1.5^{c}	0.909	0.023
Moisture	61.97^{b}	67.80^{a}	68.69^{a}	69.62^{a}	1.735	0.037
pH	5.89^{b}	5.98^{a}	6.00^{a}	5.99^{a}	0.015	0.006

SED= Standard Error of Difference, Means in the same row with different superscript are significantly different.T1, T2, T3 and T4 are beef burgers containing 0g egg albumen, 200g egg albumen, 250g egg albumen and 300g egg albumen, respectively.

prepared using egg albumen was significantly higher - (P<0.05) than the control. pH contributes to the shelf life of meat and meat products. Products with low pH has better shelf life because it creates an acidic medium, making it inappropriate for bacterial growth and reproduction (Warriss, 2000; Lawrie and Ledward, 2006; Adu-Adjei *et al.,* 2014). This means that the control beef burger will store better than the beef burgers prepared using egg albumen.

4. Conclusion

The results of the study showed that the use of egg albumen as binder at inclusion levelsof 200g, 250g and 300g per kilogram of meat had no adverse effect on the eating quality and acceptability of the beef burgers but raised the pH of the test products. The egg albumen did not increase the crude protein. The results also demonstrated that egg albumen was able to improve the cohesiveness of the beef burger. Thus fresh albumen can be used as binder at inclusion levels of 18%, 22.5% and 27%.

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