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Whole Egg of Chicken as a Binder in Beef Burger

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The suitability, yield and cohesiveness, sensory characteristics and nutritional composition of beef burger formulated with whole egg from chicken as a binder was studied. Four (4) kg of boneless beef was used,of which, 3kg were for test products and 1kg for control products. Four (4) different levels of inclusion of the whole egg per kilogram of meat that is 0g, 50g, 100g and 150g which corresponds to each treatment T1(control), T2(5%),T3(10%) and T4(15%) respectively, was examined. Spices and water were added in equal amounts of g/kg or ml/kg of meat. The burgers were moulded manually using a cylindrical tube to obtain uniform shapes and sizes. They were vacuum-packed in transparent packaging bags and stored at 4^{o}C for sensory and laboratory analyses. Lateral shrinkage and cooking loss was significantly higher for T4 (burger with highest whole egg inclusion level), but doming was significantly lower for T4. There were no significant differences in sensory characteristics among the control and the test beef burgers at the various treatment levels. Crude protein content of beef burger formulated with whole egg as a binder was improved. pH reduced at 50g inclusion level of whole egg which implies that the 5% test products were likely to store better for a longer period.

Keywords: beef burger, cohesiveness, nutritional composition, sensory characteristics, whole egg

INTRODUCTION

Meat, egg and their 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 (Siegel *et al.,*1979; Williams, 2007; USDA, 2010; Adzitey, 2011). Meat and egg albumen are major sources of proteins required by man for growth and repair of worn-out tissues (Lawrie and Ledward, 2006; Anonymous 2013). Meat and eggs also contain appreciable amounts of many of the vitamins and minerals (Siegel *et al*., 1979; Lawrie and Ledward, 2006; Williams, 2007; USDA, 2010; Adzitey 2011; Anonymous, 2013). The daily availability of proteins and other nutrients from meat in developing countries is less than in developed countries (FAO, 1992). Therefore, there is the need to develop means of processing meat to increase it nutrient composition and availability to people in developing countries.

Meat processing is a means of transforming raw meat into valuable product for consumption and storage (Aberle*et al*., 2001). Teye (2007) indicated that meat processing includes procedures such as addition of ingredients and/or mechanical action that convert fresh meat into specific products.Meat can be processed into different products among which burger is of importance. Meat processing procedure also adds value to the meat product thereby increasing the profit of the meat processor and the self-life of the meat product (FAO, 1991). One way of adding value to meat is by the use of meat extender which includes both animal and plant proteins. The common plant fillers used in Ghana include yam flour, cassava flour and soy flour (Anang, 1993; Annor-Frempong*et al.*, 1996).

A binder is something that helps a mixture to stay together. Siegel *et al*. (1979) demonstrated that egg-albumen was a good binder for meat pieces. Egg has also shown promising results as a potential meat binder in other parts of the world (Chen and Lu, 1999). One problem with locally produced burger (especially at the University for Development Studies Meat Unit and probably other places in Ghana where meat products are produced) is cohesiveness.Hence, there is the need for studies to be conducted into identifying effective binders forlocally produced burgers in Ghana.This study was therefore conducted to determine the suitability, yield and cohesiveness of wholeegg fromchickenas a binder in beef burger. The study also assesses the sensory characteristics,moisture, crude protein, crude fat and pH content of beef burger prepared using the whole egg as a binder.

MATERIALS AND METHODS

Study area

The study was conducted at the Meat Processing Unit of the University for Development Studies (UDS), Nyankpala Campus. Chemical analysis of the meat products were conducted at the Spanish Laboratory of UDS, Nyankpala.

Preparation of whole egg and beef burger

Table eggs from chicken were cracked and whisked to get desired consistency of the yolk and albumen. Four (4) kg of lean beef was obtained from the UDS Meat Laboratory and used for the experiment. The meat was thawed overnight at 4^{o}C and minced using table top mincer (Teller Ramon, Spain) through a 5mm sieve. The minced beef was divided into four treatments of 1 kg per each, mixed with spices of 1.0g black pepper, 1.0g white pepper, 2.0g mixed spice (adobo®), 15g curing salt and 0.5g red pepper. One hundred (100)ml of water was added to each treatment and mixed until a desired consistency was obtainedby feeling the texture with the hand. The four experimental treatments were formulated with 0g, 50g, 100g and 150g of inclusion level of raw egg per kilogram of beef which corresponded to products T1(control), T2(5%), T3 (10%) and T4(15%) respectively. The mixed meat was then moulded into circular shapes. The products were stored in a deep freezer for sensory evaluation.

Welling, doming, lateral shrinkage and cooking loss of beef burgers

Welling is the accumulation of fluid in vacuole of a burger and it is determined by observation. Doming (thickness) is the rise in height of a burger and was determined by measuring the height of burger before and after cooking. Lateral shrinkage (diameter) is the unnecessary shrinkage of burger towards a direction, that is, a circular shaped burger looking oval after cooking and was determined by measuring the diameter of the burger at different directions before and after cooking. Cooking loss was determined by weighing the burger before and after cooking.

Selection of taste panel and preparation of products for sensory analysis

Fifteen (15) panelists, aged between 18 and 25years were randomly selected and trained according to the British method of sensory evaluation to evaluate the product (BSI, 1993). The frozen burgers were grilled to a core temperature of 70^{o}C by the use of a 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 aluminum foil to keep it warm. Each panelist was served with the test beef burger in addition to a piece of bread and water 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 shown in Table 1.

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
Flavour	1-Very Strong 2-Strong 3-Intermediate 4-Weak 5-Very Weak
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
Cohessiveness	1-Very firm 2-Firm 3-Intermediate 4-Loose 5-Very Loose
Overallliking	1-Like Very Much 2-Like 3-Intermediate 4-Dislike 5-Dislike Very Much

Proximate analyses of beef burger

Beef burgers were analyzed for moisture, crude protein (Kjeldhal method) and fat contents (Soxtec apparatus) according to the methods of the International Association of Official Analytical Chemist (AOAC, 1999).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).

Statistical analysis

Data obtained was analyzed using Analysis of Variance (ANOVA) of the Minitab

Statistical Package, Version 15 (Minitab, 2007).

RESULTS AND DISCUSSION

Sensory characteristics of the beef burgers

The results obtained from the sensory evaluation of the beef burgers using whole egg as a binder is presented in Table 2. From Table 2, there were no significant differences ($p<0.05$) in texture, taste, juiciness, flavor, colour, cohesiveness and overall liking.Thus the incorporation of whole egg at 5%, 10% and 15% inclusion level in the beef burgers did not have any adverse effect on the burgers. Cohesiveness is the ability to hold solids and liquid together or the state of materials in a product holding together. Even though there was no significant difference in cohesiveness, beef burgers with the inclusion of whole egg tended to be firmerand most liked/preferred by the panellists (Tables 1 and 2).Various studies have indicated that protein coagulates during thermal processing, resulting in the formation of gel-like structures which bind together the batter structural units (Seigel*et al.,* 1979; Kato *et al.,* 1990; Barbut, 1995).

Table 2: Sensory characteristics of whole egg as a binder in beef burger

PARAMETER	T1 (CONTROL)	T2 (5%)	T3 (10%)	T4 (15%)	SED	SIG
Texture	2.80	2.87	2.93	2.47	0.393	ns
Taste	2.00	2.27	2.33	1.66	0.266	ns
Juiciness	2.60	2.93	2.53	2.40	0.292	ns
Flavour	2.27	2.33	2.60	2.07	0.288	ns
Colour	2.00	2.13	1.93	2.06	0.247	ns
Cohesiveness	2.33	2.00	2.20	1.93	0.340	ns
Overall liking	2.06	2.20	2.13	1.80	0.265	ns

SED=standard error of difference, ns= not significantly different

Other meat and meat product quality attributes such as texture, taste, juiciness, flavour and colour are important in determining their acceptability. For instance, Bell and Weaver (2002) reported that sulphur compounds such as hydrogen sulphide provide the flavour of meat products and meat product which does not have flavour will be disliked by consumers. Colour is an important indicator of freshness, and is one important criterion to attract customers as consumers tend to reject products which have different colour from what they are accustomed to (Mancini and Hunt, 2005; Feiner, 2006).

Welling, lateral shrinkage, doming and cooking loss of beef burgers

Welling which is the accumulation of fluid in vacuole of a burger and determined by observation was not found in

the control and test beef burgers prepared using whole egg as a binder. Accumulation of fluid in a burger after any form of cooking will make it unattractive and can face possible rejection by consumers.The burgers were weighed or measured before cooking and after cooking to determine the cooking loss, the rise in height and shrinkage towards a direction. The analysis of the beef burgers for lateral shrinkage, doming and cooking loss is shown in Table 3. There were significant differences ($p<0.01$) among the products in terms of lateral shrinkage, doming and cooking loss. Lateral shrinkage tended to be higher for the test beef burgers. It was significantly higher for the test beef burger (T4) containing the highest inclusion level (15%) of whole egg. T4 showed the highest cooking loss but the least doming effect.

Table 3: Lateral shrinkage, doming and cooking loss of beef burgers

PARAMETER	T1 (CONTROL)	T2 (5%)	T3 (10%)	T4 (15%)	SED	SIG
LS(cm)	1.37^{a}	1.60^{a}	1.43^{a}	2.10^{b}	0.133	*
Doming(cm)	0.43^{b}	0.43^{b}	0.43^{b}	0.16^{a}	0.094	*
CL(g)	42.25^{b}	39.65^{a}	39.18^{a}	53.18^{c}	0.840	**

*LS=Lateral shrinkage, CL=Cooking loss, SED=standard error of difference, Means in the same row with different superscript are significantly different,**= highly significant (p<0.01),*= significant (p<0.05).*

This may be due to excess moisture content in the T4 products since raw egg contains considerable amount of water which might have contributed additional moisture in the products. Whole egg coagulates when heated due to the egg white, and therefore served as a good binder for meat pieces in processed meat products.

Proximate composition and pH of beef burgers

The analysis of the pork sausages to determine the crude protein, crude fatand moisture shown in Table 4.There were significant differences($p<0.001$) in the crude protein,crude fat and moisture contents of the beef burgers (Table 4). Beef burger (T4) with the highest inclusion level of whole egg had the highest moisture content.This maybe attributed to the water from the whole egg, since eggs contain approximately 64% water (ICMSF, 1998). The crude protein content of the test beef burgers were all significantly higher ($p<0.001$) than the control, which is definitely due to the addition of the whole egg.According to Chen and Lu (1999), egg albumen contains mainly proteins and therefore, its addition to meat products hasthe advantage of increasing the crude protein contents of the final product.

Table 4: Proximate composition of beef burger prepared using egg as a binder

PARAMETER	CONTROL	5%	10%	15%	SED	SIG
Moisture	72.89^{c}	72.53^{b}	71.67^{a}	73.62^{d}	0.001	***
Crude protein	20.40^{a}	24.61^{c}	24.74^{d}	24.08^{b}	0.001	***
Crude Fat	10.22^{b}	9.84^{a}	11.07^{d}	10.98^{c}	0.000	***

*SED=standard error of difference, Means in the same row with different superscript are significantly different, ***= highly significant ($p<0.001$).*

The fat contents of T3 and T4 were significantly higher than the control; this may be due to the yolk present in the whole egg used in the product formulation. This however did not adversely affect the acceptability of the products indicated in Table 2. Eggs are very rich source of essential fatty acids (Orr *et al*., 1975). Fat-soluble vitamins like A, D, E and K are also mainly concentrated in the yolk while, the water-soluble vitamins are widely distributed in both the yolk and albumen (Panda, 1995).

The pH of the beef burgers is presented in Figure 1.pH which is the measure of the acidity and alkalinity in solutions or water containing substances play an important role in storability of meat and meat products. According to Warris (2010), lower pH of meat products create an acidic medium, making it inappropriate for bacterial growth and reproduction. MAFRA (2011) reported that, high pH in meat causes proliferation of bacteria and shorter shelf life of meat and meat products.

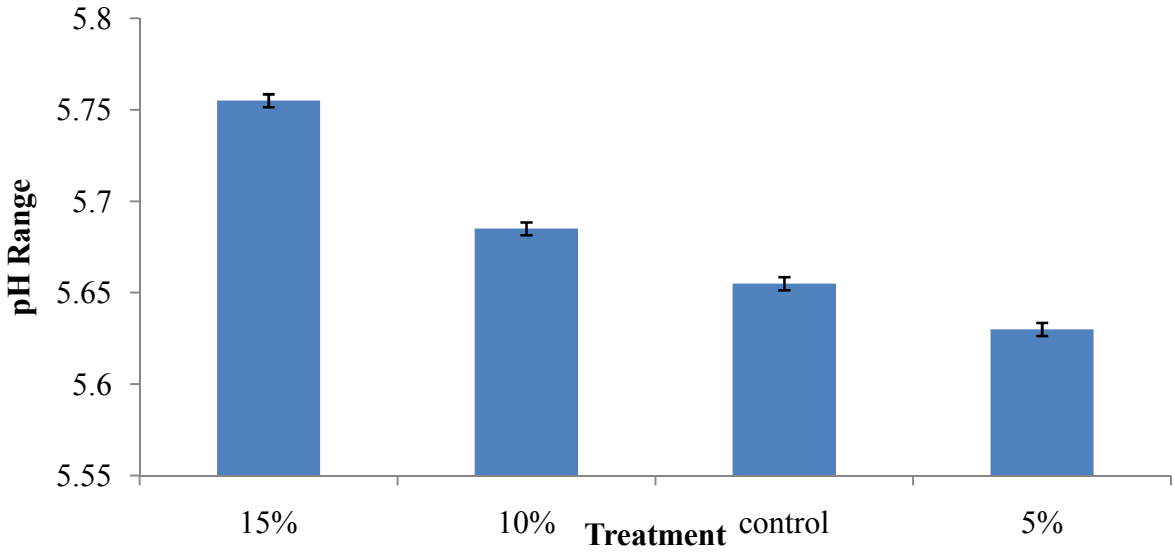

Figure 3: pH of beef burger with or without whole egg as a binder

The graph above indicate that, 5% test product had the lowest pH compared to the 10%, 15% test products and the control products. This implies that increased in the inclusion level of egg above 50g in beef burger will increase its microbial growth and activity more than products made from beef only. Since lower pH prevents microbial growth and activity, the 5% products are likely to have better storability than the control products.It is unusual for the pH of T2 (5% test product) to be lower than T1 (Control) since the pH of eggs was expected to increase the pH of T2. Vadehra and Nath (1973) reported the pH of yolk and albumen to be 6.8. The meat (beef), spices and water contributed to the pH of the test products to be less than 6.8.

CONCLUSION

The results of this study showed that, egg in the formulation of beef burger has no negative effect on the eating qualities of processed meat products when used in quantities of 50g to 150g.There was no significant difference between control and test beef burgers in terms of cohesiveness even though the test burgers had lower scores to indicate that they were firmer. Doming was not observed in the beef burgers. Crude protein content of beef burgers formulated with the whole egg as a binder was improved.

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