PROPERTIES OF MEAT CHICKEN BREAST PATTIES AS A FUNCTION OF USING SELECTED PHOSPHATE SALTS.

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SUMMARY

Meat chicken breast patties were prepared in the presence of different ratios of phosphate salts i.e. tetra sodium pyrophosphate (tetra SPP); Tri sodium pyrophosphate (tri SPP) and sodium acid pyrophosphate (SAPP). Cooking weight loss, diameter reduction, cooking density, thiobarbituric acid (TBA), pH value and water holding cabacity (WHC) were determined for the investigated samples. The available data proved that the applied ratios of the responced phosphate salts improved the cookability properties of the cooked chicken brest patties as well as the WHC of the uncooked samples. On the other hand, the applied phosphate salts minimized the rate of fat oxidation (which represents as TBA values)in both the uncooked and cooked chicken patties. However, there is a no noticiable variations in pH values; a trend which may be related to the buffering effect of the meat constituents. Statistical analysis assured all the previous results.

INTRODUCTION

Precooked poultry meat products that intering tody's the consumer market at a rapid rate are susceptible to quality changes upon short term refrigerated storage. Treatment of processed poultry with polyphosphates, in combination with salt, has shown beneficial effects for the inhibition of oxidative changes and flavour deteriorations that occur in sausage (Ang and Young 1987; Shahidi et al, 1987). Polyphosphates have also been used in meat formulations to increase water binding capacity and to improve other textural qualities (Sofos 1986). However, it has been suggested that the influence of polyphosphates on meat texture is due, in part, to their ability to increase pH and ionis strength (ISO), to chelate divalent metal cations and to interact with meat proteins (Trout and Schmidt, 1984). Among these functions, only the chelation of metal ions has been cited as a cpossible mechanism for the antioxidant effect of phosphates (Sofos 1986; Younathan 1985). On the other hand, studies have shown that adjusting pH to higher level reduced the oxidation rate in ground raw poultry meat (Chen and Waimaleongora-ek 1981).

In recent years there has been pressure from consumer groups for legislation to reduce the amount of sodium in processed foods due to the possible causal relationship between sodium inatake and hypertension. However, in most products lowering the salt level leads to a noticeable loss of functionality as exhibited by the increment of cooking loss and reduced textural properties (Sofos, 1983). The use of polyphosphates as a partial replacement of salt in different meat products has been studied for many years (Papper and Schmidt 1975). Although phosphates can effectively replace salt in most meat products, their effectiveness depends on the type of phosphate salts (Shults et al., 1972) and the conditions under which they are used (Puolanne and Terrell, 1983). From the previous view points, it was aimed through such worke to see the effect of different types of phosphate salts; i.e. tetra sodium pyrophosphate (Tetra SPP), tri sodium pyrophosphate (Tri SPP) and sodium acid pyrophosphate (SAPP) on the cooking properties (Cooking loss %, Diameter reduction and cooked density).

MATERIALS AND METHODS

A- Materials:

Whole broiless were produced from a Middle East Company, Elkaliobia Governorate. The breast meat were removed, skined and debonded after which the broiler breast meat was held at -20 C overnight and then coarsely ground (chopped) through a 1.5 cm (diameter)plate. For preparing the tested treatments, each 2 kg of the ground meat were mixed with 2% salt a and 200 mL of the responsed food grade phosphate solutions within the ratios given in Table (1). The previous ingredients were mixed with a food mixer for 1 min and then formed in patties style of about 100 g each using a 10 cm round plastic plate of kobba machine. The patties samples were weighted (raw weight) and tempered at -18 C for 10 min to assure a uniform unitial temperature and portion of which were then cooked on a wire rack over aluminum tray at 150 C for about 25 min. after which they were cooked and measured for their weights,thickness and diameter. Cooked as well as uncooked samples were packaged in a moisture proof bags and stored at -18 C for further analysis.

B- Methods of analysis:

- The moisture content and pH values were carried out according to AOAC(1980).
- Cooking loss, diameter reduction and cooking density were calculated by the equations of Young et al. (1987).

$$\% \text{ Cooking loss} = 100 \times \frac{\text{raw wt} - \text{cooked wt}}{\text{raw wt}} \qquad \%\text{Diameter reduction} = 100\text{x} \frac{10 - \text{cooked diameter}}{10.0}$$

$$\text{Cooked density} = \frac{\text{Cooked weight}}{\pi(\text{radius of patties})^2(\text{thickness of pattie})}$$

Thiobarbituric acid (TBA): Thiobarbituric acid was measured in the investigated samples as described by Vyncke (1970) and the data was given as absorbance at 538 nm.

Water holding cabacity (WHC): The water holding capacity was based on the method mentioned by Grau and Hamm method(1957)and modified by Volovinskaia and Merkoolova(1958).

Statistical analysis: Multiple regression and analysis of variance for full, regression were carried out by the SAS computer program which was applied according to Helwig (1983) using the 286 PC/AT 80286 computer; Available at the expiry Date project, Faculty of Agriculture, Ain Shams University.

RESULTS AND DISCUSSION

The meat and meat products are characterized by special cooking properties which could be summerized in the following three aspects; i.e. cooking loss, diameter reduction and cooked density. Subsequently it is important to improve these parameters in order to achieve higher quality of chicken breast patties. In such case, trials were carried out by using food grade phosphate salts and the available data are given in Tables (2-5) and Figures (1-4).

Regarding the effect of tetra sodium pyrophosphate and sodium acid pyrophosphate on the cooking loss %, Table (1) showed the superurity of the combination effect of (tetra SPP + SAPP) over the control sample. Forinstance, the cooking loss % of the control sample; "treatment A" that was 43.21% was improved and reached around 38% for the other treatments (B --- G) that containing phosphate salts. So, the investigated phosphate salts had minimized the loss % with about 12% as seen in the same table. With respect to the diameter reduction, the same table indicated that the presence of the phosphate salts (Tetra SPP+SAPP) within the given ratios minimized the shrinkage pattern of the chicken breast meat patties as seen in Fig.(1) which showed the diameter reduction level of the tested samples inrelation to the control. However, the cooked density showed a similar trend in which higher values are given for the recipes containing the previous phosphate salts.

On using other phosphate salts, such as (Tri SPP + SAPP) the cooking loss, diameter reduction and the cooked density were also improved as seen in Table (3) and Figure(2). However, Hargett et al. (1980) reported that sodium acid pyrophosphate (SAPP) is currently used by the sausage industry to accelerate development of cured meat color. On the other hand SAPP had no determintal effects on texture and may caused a slight improvement in flavor by enhancing beef, salt and seasoning flavors, as well as by diminishing fat flavor and mouthfeel. Unlike alkaline phosphates, SAPP alone did not improve moisture retention or cook yields.

It is well accepted now that cooking loss, diameter reduction and cooking density are one group of parameter which acting as a source of consumer acceptance or dissatisfaction of breast meat chicken patties. Subsequently excessive improvement in these cookability properties are of great important; a trend which was successively achieved by using the investigated phosphate salts previously given in Table (1). Such conclusion is in parallel to that of Young et al. (1987) who proved that STPP (from 0.0, 0.3 and 0.5) plus NaCl (0.0, 1.5 and 3.0) could be of valuable in improving the appearance of cooked poultry meat products by reducing strinkage. They also mentioned that the previous additives improved moisture retention and have a noticeable effect on the texture quality of the patties. In the absence of NaCl, the STPP increased the product cohesiveness, springiness and chewiness wt the highest phosphate level, but, in the presence of NaCl, the phosphate tended to increase these textural attributes,especially cohesiveness and chewiness,at lower phosphate levels.

The applied phosphate salts given in Table (1) also minimized the rate of fat oxidation which represents as TBA values as seen in Table (4). This means that phosphate salts could be served as an antioxidant during the cooking of the chicken patties. These results are in accordance with Ang and Young (1989) who also added that the antioxidant function of STPP was more important during storage of cooked samples. Other possible function of the polyphosphate salts was based on their ability to increase the pH value of meat products (Trout and Schmidt, 1983); and it is well known that higher pH slow down the oxidation process.

With such view in mind the pH values of the investigated samples were measured as seen in Table (4) which indicated that there is no noticeable variation in pH values within the applied phosphate salts. Such lack of change in the pH of the chicken breast patties was due to the buffering effect of the meat constituents. Similar conclusion was given by Ang and Young (1989). On such a base antioxidant effect of the applied phosphate salts was due to its metal-chelating ability more than to its influence on pH.

The WHC of the control chicken patties was lower than that of the other samples containing phosphate salts. Subsequently, the applied phosphate salts was most effective in improving WHC of the chicken patties containing 2% NaCl. Similar conclusion was giving by Young (1987) who mentioned that the WHC of the patties containing 2% NaCl did not differ from those containing the lower level and so STPP was most effective in improving WHC in meat products containing less than 3% NaCl. However, Hamm (1970) has summarized the effect of phsophate on the increment of WHC (water holding capacity) and presumably other functional properties such as binding strength as being due to a real increase in both pH values and ionic strength; the ability of phosphates to bind to meat proteins, and the ability of phosphates to dissociate actomyosin into actin and myosin. Similar conclusion was given by Schmidt and Trout (1982) was stated that all of the phosphates used in meat products increase both pH and ionic strength; a trend which depend upon the type and concentration of phosphate.

The muliregression analysis given in Table (6) indicated the presence of higher correlation coefficient between the tested parameters (cooking loss %, diameter reduction %, cooked density, moisture, WHC and TBA values) and the applied phosphate salts, i.e. (tetra SPP + SAPP) and (Tri SPP + SAPP). However, the estimated standard error given in the same table assure such trend.

CONCLUSION:

The relation between using different ratios of tetra sodium pyrophosphate + sodium acid pyrophosphate and the cookability properties of the cooked chicken breast patties indicated the presence of a real improvement (minimizing) in both cooking loss and Diameter reduction. A similar pattern was noticed when trisodium pyrophosphate + sodium acid pyro-

phosphate was applied through processing of the investigated samples. The water holding capacity of the uncooked chicken patties showed also a pronounced improvement as a function of using the applied phosphate salts. On the other hand, the possible function of the polyphosphate salts was based on the ability to increase the pH value of meat products; and it is well known that higher pH slow down the oxidation process. However, the applied phosphate salts also minimized the rate of a fat oxidation which represents as TBA values.This means that phosphate salts could be served as an antioxidant during the cooking of the chicken patties.

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Table (1): Ratios of food grade phosphate salts used in preparing chicken breast patties.

Treatments	Phosphate salts		Treatments	Phosphate salts	
	Tetra SPP %	SAPP %		Tri SPP %	SAPP %
A	0.0	0.0	AA	0.0	0.0
B	0.5	0.0	BB	0.5	0.0
C	0.4	0.1	CC	0.4	0.1
D	0.3	0.2	DD	0.3	0.2
E	0.2	0.3	EE	0.2	0.3
F	0.1	0.4	FF	0.1	0.4
G	0.0	0.5	GG	0.0	0.5

Tetra SPP : Tetra sodium pyrophosphate.
SAPP : Sodium acid pyrophosphate.
Tri SPP : Tri sodium pyrophosphate.

N.B. : Treatments A to G or AA to GG were based on the research of Marcy et al. 1988.

Table (2): Effect of using tetra sodium pyrophosphate + sodium acid pyrophosphate on the cookability properties of cooked chicken breast patties.

Phosphate treatments	Tested parameters: Cooking loss		Diameter reduction		Cooked density	
	%	Improvement level	%	Improvement level	g/cm^3	Improvement level
A	43.21	-	17.20	-	0.93	-
B	38.05	11.94	15.21	11.57	0.96	-3.23
C	38.07	11.87	15.20	11.63	0.95	-2.15
D	38.08	11.87	15.19	11.63	0.96	-3.23
E	38.10	11.83	15.20	11.63	0.95	-2.15
F	38.09	11.85	15.18	11.74	0.96	-3.23
G	38.07	11.90	15.19	11.69	0.96	-3.23

Table (3): Effect of using Tri sodium pyrophosphate + sodium acid pyrophosphate on the cookability properties of cooked chicken breast patties.

Phosphate treatments	Tested parameters: Cooking loss		Diameter reduction		Cooked density	
	%	Improvement level	%	Improvement level	g/cm^3	Improvement level
AA	43.95	-	16.80	-	0.91	-
BB	38.84	11.63	15.05	10.42	0.95	-4.40
CC	38.80	11.72	15.15	9.82	0.94	-3.30
DD	38.89	11.51	15.12	10.00	0.95	-4.40
EE	38.85	11.60	15.10	10.12	0.95	-4.40
FF	38.84	11.63	15.08	10.24	0.94	-3.30
GG	38.87	11.56	15.13	9.94	0.95	-4.40

Table (4): Effect of using tetra sodium pyrophosphate + sodium acid pyrophosphate on some properties of cooked and uncooked chicken breast patties.

Phosphate treatments	Uncooked samples: Moisture	Dry-matter	pH	WHC %	TBA values mg Molonaldhyde/kg sample: Unkooked	Cooked
A	56.25	43.75	6.20	30.92	0.71	0.85
B	59.95	40.05	6.45	39.95	0.65	0.70
C	59.93	40.07	6.31	39.90	0.64	0.70
D	59.95	40.05	6.25	39.92	0.65	0.69
E	59.94	40.06	6.21	39.93	0.64	0.69
F	59.95	40.05	6.15	39.94	0.65	0.68
G	59.93	40.07	6.05	39.95	0.63	0.68

Table (5): Effect of using Tri sodium pyrophosphate + sodium acid pyrophosphate on some properties of cooked and uncooked chicken breast patties.

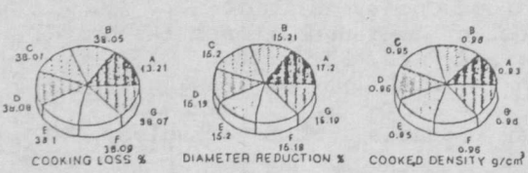
Phosphate treatments	Uncooked samples: Moisture	Dry-matter	pH	WHC %	TBA values mg Molonaldhyde/kg sample: Unkooked	Cooked
AA	56.30	43.70	6.19	31.21	0.69	0.86
BB	59.99	40.01	6.17	39.80	0.64	0.69
CC	59.98	40.02	6.15	39.81	0.63	0.70
DD	59.99	40.01	6.12	39.82	0.64	0.70
EE	59.97	40.03	6.10	39.85	0.63	0.69
FF	59.98	40.02	6.05	39.84	0.65	0.69
GG	59.98	40.02	6.02	39.83	0.64	0.69

Table (6): Multiregression analysis of some properties of the uncooked and cooked breast chicken patties.

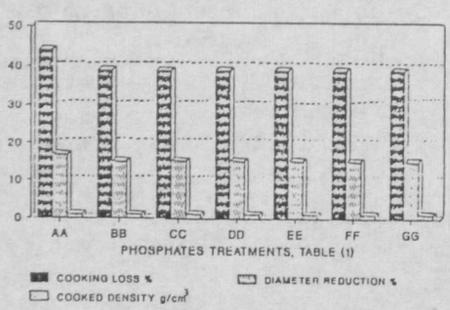
Tested parameters of	Statistical variables: R-Squared I	R-Squared II	Std. error I	Std. error II
Cooking loss %*	0.999953	0.999824	0.016359	0.021335
Diam.reduction %*	0.999340	0.997514	0.075590	0.039170
Cooked density g/cm^3*	0.828205	0.896296	0.005648	0.005774
Moisture**	0.999960	0.999982	0.010579	0.007303
WHC %**	0.999970	0.999890	0.020260	0.013310
TBA: Uncooked	0.941609	0.903704	0.007777	0.007868
Cooked*	0.994926	0.995386	0.005255	0.005255

I : (Tetra SPP + SAPP)
II : (Tri SPP + SAPP)
* : Cooked samples.
** : Uncooked samples.

FIG(1)EFFECT OF TETRA SPP+SAPP ON THE COOKABILITY PROPERTIES OF COOKED C.B.P.



FIG(2)EFFECT OF TRI SPP+SAPP ON THE COOKABILITY PROPERTIES OF COOKED C.B.P.



C.B.P. = Chicken breast patties.

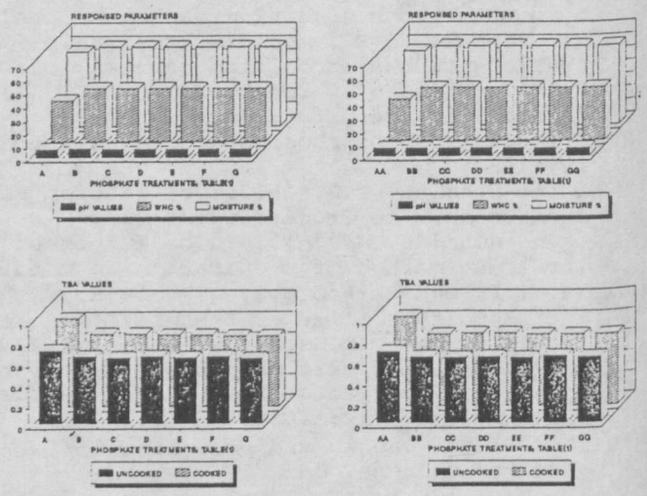


Fig.(3): Effect of using tetrasodium pyrophosphate + sodium acid pyrophosphate (A to G) and trisodium pyrophosphate + sodium acid pyrophosphate (AA to GG) on some properties of cooked and uncooked chicken breast patties.