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The Effect of Hot Curing on Quality Characteristics of Cured Pork

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ABSTRACT. *The effect of hot curing on quality characteristics of cured pork was investigated. Pork was cured at 2-4°C for one week in a curing mixture which did not contain phosphate (control). The other forms of treatment of the experiment were, pork cured with and without phosphate in curing mixtures for different time periods (30 min, 1 h and 2 h) at 28°C and 60°C. The water holding capacity of samples cured without phosphate had an inverse relationship ($P<0.05$) with curing time at 28°C and 60°C. However, the water holding capacity of pork cured with phosphate did not change ($P<0.05$) during the curing periods at both temperatures. At both temperatures, the samples cured with phosphate showed higher ($P<0.05$) water holding capacities than those cured without phosphate. The water holding capacity of pork cured at 60°C, was lower than the control and all the samples cured at 28°C.*

Pork cured for 1 h had higher ($P<0.05$) weight gain than the sample cured for 30 min and 2 h, with or without phosphate at 28°C. Weight gain of pork decreased ($P<0.05$) with an increase in curing time at 60°C. However, the addition of phosphate to the curing mixture increased weight gain at both 28°C and 60°C.

Cooking loss of samples cured without phosphate at 28°C and 60°C had a positive relationship with the curing time. However, samples cured with phosphate showed no significant ($P<0.05$) changes in cooking loss, with an increase in time at both 28°C and 60°C. The addition of phosphate to the curing mixture decreased cooking loss. Cooking loss of samples cured at 28°C was lower than the samples cured at 60°C.

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According to sensory evaluation, the sample cured with phosphate for 1 h at 28°C scored significantly ($P<0.05$) the highest value ($P<0.05$) for all quality characteristics, except juiciness. This sample was placed second for juiciness.

These results indicated that pork cured with phosphate for 1 h at 28°C was more favourable than the other forms of treatments.

INTRODUCTION

Curing is one of the most important operations in processed meat production. A considerable amount of research has been done on traditional curing of meat. The length of the curing period is one of the factors affecting the efficiency of the curing process and the cost of the final product. According to Pearson and Tauber (1984), hot curing of pork reduces the curing period. Hot curing may also cause some changes on the quality of the final product. However, there is no information available on hot curing under Sri Lankan conditions. Therefore, this work was conducted to study the effect of hot curing on quality characteristics of cured pork, under local conditions.

MATERIALS AND METHODS

Pork was deboned, cut into small pieces and accurately weighed (100 g). Two curing mixtures were prepared. One mixture contained sodium chloride (7.55%), sugar (3.77%), sodium nitrite (0.08%) and water (88.60%). The other curing mixture contained sodium monophosphate, (0.50%) in addition to the above ingredients.

The control sample was cured at 2-4°C for one week in curing mixture without phosphate. The other samples of pork were cured in both curing mixtures for different time periods (30 min, 1 h and 2 h) at 28°C and 60°C. All treatments were triplicated. The objective parameters, such as, water holding capacity, weight gain, cooking loss and salt content were measured. A sensory evaluation was also conducted for the samples to assess the overall acceptability, by using 13 panelists. Data on objective measurements were analyzed using a Student T-test technique. The results of sensory evaluation were analyzed using a non - parametric test.

RESULTS AND DISCUSSION

Water holding capacity

Values for water holding capacity of meat samples cured for different time periods at 2-4°C, 28°C and 60°C are given in Table 1. When curing time was increased, water holding capacity of samples cured without phosphate decreased during the curing period at 28°C and 60°C. This is probably due to the denaturing of muscle protein (Lawrie, 1985). However water holding capacities of samples cured with phosphate at 28°C and 60°C were not significantly different ($P<0.05$), regardless of curing time. This is probably due to an increase in pH of meat, as a result of added phosphate (Townsend *et. al.*, 1979; Pearson and Tauber, 1984).

The samples cured with phosphate had higher ($P<0.05$) water holding capacity values than the samples cured without phosphate at both 28°C and 60°C. This may be due to the ability of phosphate to hold more water (Pearson and Tauber, 1984). Curing of meat with or without phosphate at 28°C for a shorter period (up to 2 h) had a higher water holding capacity than the sample cured without phosphate at 2-4°C for 1 week (control).

However, when the curing temperature was increased to 60°C, the water holding capacity decreased. This is probably due to the denaturing of protein at 60°C. These findings are in agreement with Lawrie (1985).

Weight gain

Meat samples cured for different time periods at 2-4°C, 28°C and 60°C gained weight as shown in Table 2. Pork cured for 1 h had a higher weight gain than the samples cured at 28°C for 30 min and 2 h, with or without phosphate. The optimum time for curing at 28°C could be considered as 1 h. These results are in agreement with Pearson and Tauber (1984). At 60°C, the samples cured with or without phosphate showed significant ($P<0.05$) decrease in weight gain, with an increase in curing time. This could be a result of denaturing of muscle protein (Lawrie, 1985).

Table 1. Water holding capacity (WHC) of meat samples cured for different time periods at 2-4°C (control), 28°C and 60°C.

Treatment	Water holding capacity (Mean ± S.D.) Cured for 30 min	Cured for 1 h	Cured for 2 h	Cured for 1 week
Control	-	-	-	65.42+ 1.91[a]
Without phosphate at 28°C	72.79± 2.78[b]	69.45± 2.68[c]	67.36± 5.77[a]	-
With Phosphate at 28°C	73.89± 2.13[b]	73.33± 1.00[b]	71.86± 1.14[b]	-
Without Phosphate at 60°C	57.51± 6.59[d]	55.10± 1.52[e]	50.87± 1.51[f]	-
With Phosphate at 60°C	58.89± 5.01[d]	57.84± 3.01[d]	57.24± 3.88[d]	-

Means with different superscripts (a,b,c,d,e, and f) are significantly ($P<0.05$) different.

Samples cured without phosphate at 28°C, for 1 h had a higher ($P<0.05$) value for weight gain than that of the control. The optimum time for curing at 28°C was shown to be 1 h (Pearson and Tauber, 1984). However, the addition of phosphate to the curing mixture increased the weight gain of the samples at 28°C. These values were higher ($P<0.05$) than that of the control. These results are in agreement with Townsend *et. al.*, (1979).

Table 2. Weight gain by meat samples cured for different time periods at 2-4°C (control), 28°C and 60°C.

	Weight gain % (Mean ± S.D.)			
Treatment	Cured for 30 mins	Cured for 1 h	Cured for 2 h	Cured for 1 week
Control	-	-	-	7.27+ 0.74[a]
Without Phosphate at 28°C	7.24± 0.57[a]	8.36± 0.16[b]	7.36± 0.51[a]	-
With phosphate at 28°C	8.54± 1.10[b]	9.20± 0.49[c]	8.62± 0.61[b]	-
Without Phosphate at 60°C	5.46± 0.93[d]	4.93± 0.49[e]	4.01± 1.02[f]	-
With Phosphate at 60°C	6.64± 1.15[g]	6.09± 1.40[h]	5.59± 0.60[d]	-

Means with different superscripts (a,b,c,d,e,f,g and h) are significantly ($P<0.05$) different.

The samples cured with or without phosphate at 60°C showed lower ($P<0.05$) weight gain than that of the control, and the samples cured at 28°C with or without phosphate. This is probably due to denaturing of protein (Lawrie, 1985). Even though the weight gain increased due to added phosphate at 60°C, these values were lower ($P<0.05$) than that of the control and all the samples cured at 28°C. These findings are in agreement with Townsend *et. al.*, (1979) and Pearson and Tauber (1984).

Cooking loss

The data on cooking loss of meat samples cured for different time periods at 2-4°C, 28°C, and 60°C are shown in Table 3. Cooking loss of samples cured without phosphate at 28°C and 60°C increased significantly, ($P<0.05$) with increase in curing time. It could be due to denaturing of proteins (Lawrie, 1985). However, addition of phosphate did not have a significant effect ($P<0.05$) on cooking loss of these samples. This could be due to an improved water holding capacity of meat (Table 1) as a result of added phosphate (Townsend *et. al.*, 1979; Pearson and Tauber, 1984).

Table 3. Cooking loss of meat samples cured for different time periods at 2-4°C (control), 28°C and 60°C.

	Cooking Loss % (Mean ± S.D.)			
Treatment	Cured for 30 mins	Cured for 1 h	Cured for 2 h	Cured for 1 week
Control	-	-	-	18.46± 2.56[a]
Without Phosphate at 28°C	15.15± 1.77[b]	16.92± 1.42[c]	18.17± 1.62[a]	-
With Phosphate at 28°C	14.92± 1.52[b]	14.82± 0.97[b]	15.86± 1.31[b]	-
Without Phosphate at 60°C	2092± 1.92[d]	23.84± 0.98[e]	26.43± 1.24[f]	-
With Phosphate at 60°C	19.74± 1.07[d]	20.76± 2.13[d]	20.22± 1.82[d]	-

Means with different superscripts (a,b,c,d,e, and f) are significantly ($P<0.05$) different.

Cooking losses were generally lower in the samples cured with or without phosphate at 28°C than that of the control. This is probably due to their higher water holding ability (Table 1), which was also reported by Lawrie (1985). However, addition of phosphate into the curing mixture at 28°C resulted in a further decrease in cooking loss. These results are in agreement with Townsend *et. al.*, (1979). The samples cured with or without phosphate at 60°C had higher values ($P<0.05$) for cooking loss than that of the control and the samples cured at 28°C. These higher values could be a result of denaturing of protein (Lawrie, 1985). But, the cooking loss decreased when phosphate was included in the curing mixture. This is probably due to an increase in water holding capacity by phosphate, which was also reported by Paul (1972) and Townsend *et. al.*, (1979). However, these values were higher than that of the control, and the samples cured at 28°C. This could be a result of denaturing of protein at 60°C (Lawrie, 1985).

Salt content

The data on salt content are given in Table 4. Salt contents were not significantly ($P<0.05$) influenced by curing period, curing temperature or presence of phosphate in the curing mixture, although the values range from 3.48% to 5.15%. These results are in agreement with the findings of Wildes *et. al.*, (1977).

Sensory evaluation

Means of the scores given by the tasting panel are presented in Table 5. Pork cured with or without phosphate at 28°C for 1 h scored more ($P<0.05$) than those cured for 30 min and 2 h, for all quality characteristics except juiciness. Curing at 28°C for 1 h with phosphate had higher values for all quality characteristics except juiciness, than the sample cured with or without phosphate for 30 min and 2 h. This may be due to the addition of phosphate.

The sample cured without phosphate at 60°C for 30 min scored more ($P<0.05$) on all quality characteristics except texture, than the samples treated without phosphate for 1 h and 2 h. However, pork cured with phosphate at 60°C for 1 h produced a better quality product than that cured for 30 min and 2 h.

Table 4. Salt content of meat samples cured for different time periods at 2-4°C (control), 28°C and 60°C.

	Salt content % (Mean ± S.D.)			
Treatment	Cured for 30 mins	Cured for 1 h	Cured for 2 h	Cured for 1 week
Control	-	-	-	5.15+ 0.75[a]
Without Phosphate at 28°C	3.95± 0.55[a]	4.70± 0.95[a]	4.45± 0.62[a]	-
With phosphate at 28°C	3.75± 0.87[a]	4.38± 0.80[a]	4.02± 0.90[a]	-
Without Phosphate at 60°C	3.80± 0.65[a]	3.56± 0.72[a]	3.74± 0.94[a]	-
With Phosphate at 60°C	3.48± 0.95[a]	3.75± 0.77[a]	4.10± 0.87[a]	-

Means with different superscripts are significantly ($P<0.05$) different.

The control samples received higher scores ($P<0.05$) for all quality characteristics, than the samples cured with or without phosphate at 60°C. The control also received higher scores ($P<0.05$) than the samples cured without phosphate at 28°C, on all quality characteristics except colour and juiciness. The samples cured with phosphate at 28°C for 1h had higher scores ($P<0.05$) on all quality characteristics than the control. This may be due to the addition of phosphate.

Table 5. Sensory evaluation test: Means of the scores given by the tasting panel.

Treatment / Characteristics	Control	Without phosphate at 28°C			With phosphate at 28°C			Without phosphate at 60°C			With phosphate at 60°C		
		cured for 30 m.	cured for 1 h	cured for 2 h	cured for 30 m.	cured for 1 h	cured for 2 h	cured for 30 m.	cured for 1 h	cured for 2 h	cured for 30 m.	cured for 1 h	cured for 2 h
1. Appearance	5.30^{a}	3.82^{b}	4.50^{c}	4.40^{d}	5.00^{e}	5.71^{f}	4.70^{g}	4.00^{h}	3.65^{i}	3.50^{j}	3.10^{k}	4.20^{l}	3.32^{m}
2. Colour	4.92^{a}	4.12^{b}	5.43^{c}	4.48^{d}	4.81^{e}	5.60^{f}	5.29^{g}	4.31^{h}	3.93^{i}	3.53^{j}	3.26^{k}	4.65^{l}	3.40^{m}
3. Texture	5.32^{a}	4.10^{b}	4.81^{c}	4.50^{d}	4.71^{e}	5.72^{f}	5.00^{g}	2.68^{h}	3.11^{i}	3.87^{j}	3.32^{k}	4.30^{l}	3.64^{m}
4. Taste	5.12^{a}	3.30^{b}	4.53^{c}	4.35^{d}	4.97^{e}	5.44^{f}	4.73^{g}	4.00^{h}	3.85^{i}	2.85^{j}	3.61^{k}	4.21^{l}	3.00^{m}
5. Juiciness	4.15^{a}	4.74^{b}	4.45^{c}	4.31^{d}	5.18^{e}	4.90^{f}	4.61^{g}	3.51^{h}	3.25^{i}	2.72^{j}	4.00^{k}	3.75^{l}	3.00^{m}
6. General acceptability	4.80^{a}	3.51^{b}	4.31^{c}	4.11^{d}	4.63^{e}	5.12^{f}	4.48^{g}	3.72^{h}	3.28^{i}	3.00^{j}	2.50^{k}	3.90^{l}	2.74^{m}

The sample cured with phosphate at 28°C for 1 h had the highest score ($P<0.05$) on all quality characteristics, except juiciness. For juiciness, the sample cured with phosphate at 28°C for 30 min scored the highest value, ($P<0.05$) followed by the sample cured with phosphate at 28°C for 1 h.

CONCLUSIONS

According to the overall results, the sample cured with phosphate at 28°C for 1 h is the most favourable form of treatment.

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