

EFFECT OF ORGANOLEPTIC QUALITIES OF PORK ON VACUUM PACKAGING AND STORAGE

V. Venkataramanujam, K. Dushyanthan*, Robinson, J.J. Abraham** and A.M. Shanmugam

Department of Meat Science & Technology

Madras Veterinary College

Chennai - 600 007, India

Vacuum packaging has been increasingly used to minimize shrinkage loss, discoloration and improve the keeping quality of meat. Vacuum packaged pork loins sustained less shrinkage, evidenced a lower incidence of off-odour, were higher in consumer acceptability, maintained acceptability as wholesale cuts and produced highly satisfactory retail cuts in appearance and odour following 28 days of storage at 2°C than loins wrapped in parchment paper and PVC films (Smith *et al.*, 1974). Pork loin chops packed under vacuum were superior in maintaining desirable odour and appearance scores to chops packed in PVC films (Vrana *et al.*, 1985). In vacuum packaged bacon stored at 6°C for <26 weeks no off odour was observed and the flavour became stronger and aroma improved

during storage (Havas, 1988). Boden (1992) opined that vacuum packaging had proven to prevent evaporation, weight loss, fat oxidation, blood/liquid drip, need for surface trimming, freezer burn and extended shelf-life of products such as meat, poultry, cooked meats, fish, etc. According to Spanier *et al.* (1992) vacuum storage of beef completely retarded flavour deterioration.

Stapelfeldt *et al.* (1993) reported that sensory quality of meat packed in polyethylene was clearly inferior to vacuum packed and modified atmospheric packed meat which was high through out the storage period of 14 days at 4°C. Beef packed in PET/poly material, under vacuum and stored up to 60 days at -10°C had the highest odour score (Venkataramanujam, 1994).

* Presently working as Associate Professor, Department of Meat Science & Technology, Veterinary College & Research Institute, Namakkal - 637001, Tamil Nadu

** Director of Animal Research, Tamil Nadu Veterinary and Animal Science University, Chennai

The purpose of this study was to evaluate effects of organoleptic qualities like odour, appearance, flavour, juiciness and tenderness scores of packed pork and to find a suitable packaging material for packaging pork under vacuum method and under different storage periods.

Materials and Methods

Twenty two pork samples obtained from the Department of Meat Science and Technology, Madras Veterinary College were utilized for conducting the study. The fresh pork samples were packed in low density polyethylene (LDPE) monolayer and two layers, polyester/polyethylene (PET/Poly) and multilayer (LDPE + Bonding agent + Nylon 6 + Bonding agent + LDPE - ML) pouches under ordinary and vacuum packaging.

The odour score and the taste panel scores were assessed after 72, 96 and 120 hours of storage at $5 \pm 2^\circ\text{C}$ and after 30 and 60 days of storage at -10°C . The odour score of packed pork was assessed by a trained laboratory panel of seven members as described by Pearson (1968). The taste panel scores were assessed by subjecting the packed pork samples to a sensory analysis of appearance, flavour, juiciness and tenderness by a trained five member taste panel on a nine point hedonic score card. The data

obtained were analysed statistically (Snedecor and Cochran, 1968).

Results and Discussion

The mean \pm SE and the analysis of variance of odour and taste panel scores of pork packed under two methods, in four different materials and stored for different periods at $5 \pm 2^\circ\text{C}$ at -10°C are furnished in Tables 1 and 2 respectively.

The analysis of variance of the odour of pork packed under two methods and in four material revealed highly significant ($P < 0.01$) differences between them, respectively. Pork packed under vacuum and in PET/poly material had the highest odour, and taste panel scores, respectively.

Highly significant ($P < 0.01$) differences were noticed on analysis of variance of odour, appearance, flavour and juiciness scores of pork stored in three periods at $5 \pm 2^\circ\text{C}$. Pork stored up to 96 h at $5 \pm 2^\circ\text{C}$ had the highest odour, appearance, flavour and juiciness scores.

The two-way interactions between the packaging methods and material, the packaging methods and the periods of storage at $5 \pm 2^\circ\text{C}$ on the analysis of variances of odour and taste panel scores of packed and stored pork showed highly significant ($P < 0.01$) differences, respectively.

Table 1. Mean \pm SE and analysis of variance of odour score and taste panel scores of pork packed in four packaging materials, under two methods and stored for three periods at $5 \pm 2^\circ\text{C}$

Groups	Parameters				
	Odour score	Taste Panel Scores			
		Appearance	Flavour	Juiciness	Tenderness
Materials					
LDPE - Monolayer	8.73 ^c	7.87 ^a	7.91 ^b	7.86 ^a	8.04 ^a
LDPE - Twolayer	8.51 ^a	7.95 ^a	8.17 ^c	8.10 ^b	8.25 ^a
Polyester/ Polyethylene	8.68 ^{bc}	8.31 ^b	8.34 ^d	8.32 ^c	8.47 ^b
Multilayer	8.61 ^b	7.89 ^a	7.80 ^a	7.84 ^a	8.18 ^a
F value	14.67 ^{**}	13.28 ^{**}	127.50 ^{**}	26.33 ^{**}	9.44 ^{**}
SE	0.025	0.05	0.020	0.043	0.058
CD	0.09	0.19	0.07	0.16	0.21
Methods					
Ordinary Packaging	8.59 ^a	7.98 ^a	7.98 ^a	7.94 ^a	8.13 ^a
Vacuum Packaging	8.69 ^b	8.13 ^b	8.14 ^b	8.12 ^b	8.35 ^b
F value	15.33 ^{**}	8.9 ^{**}	93.00 ^{**}	16.78 ^{**}	11.88 ^{**}
SE	0.018	0.036	0.01	0.031	0.041
CD	0.06	0.13	0.05	0.11	0.15
Periods					
72 hours	8.77 ^b	8.03 ^{ab}	8.11 ^b	8.03 ^b	8.18 ^a
96 hours	8.80 ^b	8.18 ^b	8.23 ^c	8.20 ^c	8.42 ^b
120 hours	8.35 ^a	7.95 ^a	7.87 ^a	7.87 ^a	8.11 ^a
F value	140.33 ^{**}	70.45 ^{**}	99.75 ^{**}	30.78 ^{**}	10.87 ^{**}
SE	0.022	0.044	0.018	0.038	0.05
CD	0.08	0.16	0.06	0.14	0.18

NS - Non-significant ($P > 0.05$)

** - Highly Significant ($P < 0.01$)

LDPE - Low Density Polyethylene

Means with atleast one common superscript within a class do not differ significantly ($P > 0.05$)

Table 2. Mean \pm SE and analysis of variance of odour score and taste panel scores of pork packed in four packaging materials under two methods and stored for two periods at -10°C

Groups	Parameters				
	Odour score	Taste Panel Scores			
		Appearance	Flavour	Juiciness	Tenderness
Materials					
LDPE - Monolayer	8.12 ^b	7.86 ^a	7.76	7.65	8.03 ^{ab}
LDPE - Twolayer	7.77 ^a	7.94 ^a	7.78	7.58	7.86 ^a
Polyester/ Polyethylene	8.14 ^a	8.13 ^b	7.95	7.90	8.20 ^b
Multilayer	8.28 ^b	7.99 ^{ab}	7.86	7.76	8.10 ^b
F value	8.37**	3.29*	0.27 ^{NS}	2.23 ^{NS}	5.23**
SE	0.077	0.066	0.108	0.09	0.064
CD	0.28	0.18	-	-	0.23
Methods					
Ordinary Packaging	7.92 ^a	7.88 ^a	7.76	7.61 ^a	7.92 ^a
Vacuum Packaging	8.24 ^b	8.03 ^b	7.90	7.83 ^b	8.17 ^b
F value	3.25**	5.00*	0.79 ^{NS}	5.73*	14.77**
SE	0.054	0.05	0.153	0.064	0.045
CD	0.20	0.14	-	0.18	0.16
Periods					
30 days	8.10	7.93	7.87	7.84 ^b	8.13 ^b
60 days	8.06	7.98	7.80	7.59 ^a	7.96 ^a
F value	0.06 ^{NS}	0.43 ^{NS}	0.25 ^{NS}	7.77**	6.85*
SE	0.054	0.047	0.108	0.064	0.045
CD	-	-	-	0.23	0.12

NS - Non-significant ($P > 0.05$)

* - Significant ($P < 0.05$)

** - Highly Significant ($P < 0.01$)

LDPE - Low Density Polyethylene

Means with atleast one common superscript within a class do not differ significantly ($P > 0.05$)

Pork packed under vacuum and in PET/poly material had the highest odour, appearance, flavour, juiciness and tenderness scores. Pork packed under vacuum and stored up to 72 h at $5\pm 2^\circ\text{C}$ recorded the highest odour score. The highest odour score was reported in pork packed in ML material and stored up to 96 h at $5\pm 2^\circ\text{C}$.

Pork packed under vacuum and stored up to 96 hours at $5\pm 2^\circ\text{C}$ recorded the highest taste panel scores. Highest taste panel scores were revealed in pork packed in PET/poly and stored up to 96 h at $5\pm 2^\circ\text{C}$.

The three-way interaction between the packaging methods, material and periods of storage on analysis of variance of odour, flavour and tenderness scores of pork packed and stored at $5\pm 2^\circ\text{C}$ recorded highly significant ($P < 0.01$) differences, respectively.

Pork packed under ordinary packaging, in LDPE monolayer material and stored up to 96 h at $5\pm 2^\circ\text{C}$ had the highest odour score. Pork packed under vacuum in PET/poly and stored up to 96 h at $5\pm 2^\circ\text{C}$ recorded highest flavour and tenderness scores.

The anaerobic atmosphere under vacuum method, the barrier to transmission of oxygen by the PET/poly material and the shorter duration of storage improved the odour and

taste panel scores of pork. Similar results have been reported by Smith *et al.* (1974), Vrana *et al.* (1985), Havas (1988), Spanier *et al.* (1992) and Stapelfeldt *et al.* (1993).

On analysis of variance highly significant ($P < 0.01$) differences in odour and tenderness scores and significant ($P < 0.05$) differences in appearance and juiciness scores of pork packed under the two methods of packaging at -10°C were noticed. Pork packed under vacuum revealed the highest odour, appearance, juiciness and tenderness scores.

Highly significant ($P < 0.01$) differences were noticed in odour and tenderness scores and significant ($P < 0.05$) difference was noticed in appearance score of pork packed in four different packaging material at -10°C on analysis of variance. Pork packed in ML material recorded the highest odour score and those packed in PET/poly material recorded the highest appearance and tenderness scores.

Significant ($P < 0.01$) differences were noticed in juiciness and tenderness scores of packed pork stored at two different periods at -10°C , on analysis of variance. Pork packed and stored up to 30 days at -10°C reported the highest juiciness and tenderness scores.

On analysis of variance of the two-way interactions between the packaging methods and material, the packaging methods and periods of storage at -10°C and the packaging material and periods of storage on the odour, juiciness and tenderness scores of pork stored at -10°C revealed highly significant ($P < 0.01$) differences, respectively.

The two-way interactions between the packaging methods and material and the packaging methods and periods of storage of pork at -10°C revealed significant ($P < 0.05$) differences and the two-way interactions between the packaging material and periods of storage of pork at -10°C revealed highly significant ($P < 0.01$) difference on appearance score of pork.

Pork packed under vacuum and in ML material, under vacuum and stored up to 60 days and packed in ML material and stored up to 60 days at -10°C recorded the highest odour score. Pork packed under vacuum and in PET/poly material, under vacuum and stored up to 30 days at -10°C and in PET/poly and stored up to 30 days at -10°C had the highest appearance, juiciness and tenderness scores, respectively.

The three-way interaction between the packaging methods, material and

periods of storage of pork at -10°C on analysis of variance revealed highly significant ($P < 0.01$) differences on the juiciness and tenderness scores of pork. Pork packed under vacuum, in PET/poly and stored up to 30 days recorded the highest juiciness and tenderness scores.

Vacuum packed and frozen stored pork revealed higher odour and taste panel scores. Under vacuum conditions the low amount of oxygen controls the production of rancidity and hence the odour and taste panel scores are not affected. Similar findings were reported by Boden, (1992) and Venkataramanujam (1994).

The results obtained from the above study can be concluded that the odour and taste panel scores of pork are maintained better when packed under vacuum in oxygen-impermeable material like PET/poly and ML material under both the refrigeration and freezer storage conditions.

Summary

The effect on organoleptic qualities of pork of vacuum packaging and storage was studied. Pork packed under vacuum in PET/poly material and stored upto 96 h at $5\pm 2^{\circ}\text{C}$ had the highest odour and taste panel scores, respectively. Pork packed under vacuum recorded the highest odour, appearance, juiciness and tenderness

scores. Pork packed in ML material had the highest odour score and those packed in PET/poly material the highest appearance and tenderness scores. Pork packed and stored up to 30 days reported the highest juiciness and tenderness scores. It can be concluded that the pork packed under vacuum, in oxygen-impermeable material like PET/poly and ML and stored for shorter durations at both the refrigeration and freezer conditions enhanced the odour and taste panel scores and thereby the organoleptic qualities.

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References

- Boden, M. (1992). New trends in vacuum and gas flush packaging. *European Food and Drink Review. Autumn.* **145**: 147. Quoted in *Food Science and Technology Abstracts*, **24**: 89
- Havas, F. (1988). Judging of back bacon packed in bags. *Fleisch wirtschaf.* **68**: 758-760. Quoted in *Food Science and Technology Abstracts*. **21**:96
- Pearson, D. (1968). Application of chemical methods for the assessment of beef quality. I. General consideration, sampling and the determination of basic components. *J. Sci. Fd. Agric.* **19**: 364-366
- Smith, G.C., Rape, S.W., Motycka, R.R. and Carpenter, Z.L. (1974). Packaging systems for extending the storage life of pork cuts. *J. Food Sci.* **39**: 1140-1144
- Snedecor, G.W. and Cochran, W.G. (1968). *Statistical Methods*. 6th Ed. The Iowa State University Press, IOWA, USA
- Spanier, A.M., Vercellotti, L.R. and James, J.R.C. (1992). Correlation of sensory instrumental and chemical attributes of beef as influenced by meat structure and oxygen exclusion. *J. Food Sci.* **57**: 10-15
- Stapelfeldt, H., Bijorn, V., Skilisted, L.M. and Bertelsen, G. (1993). Zeitschrift fur lebensmitteluntersuchung und-forschung. *Food Sci. Tech. Abst.* **25**: 65-321
- Venkataramanujam, V. (1994). Evaluation of shelf-life of beef in different packaging materials

under different temperatures.

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Vrana, J.A., Savell, J.W., Dill, C.W., Smith, G.S., Ehlers, J.G.

and Vanderzant, C. (1985). Retail appearance, odour and microbiological characteristics of pork loin chop packaged in different oxygen-barrier films as affected by loin storage treatment. *J. Food Protect.* **48**:476-481