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The effects of brined onion extracts on lipid oxidation and sensory quality in refrigerated cooked turkey breast rolls during storage

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Abstract

The effects of brined onion extracts on selected aspects of quality in cooked encased turkey breast rolls were evaluated during refrigerated storage over 7 days. Using the thiobarbituric acid (TBA) assay, a 50% strength juice gave a significant reduction ($P < 0.0001$) in lipid oxidation in both 100 g and 1 kg rolls relative to controls. Quercetin, the main onion juice antioxidant, was reduced by 65% in freshly cooked 1 kg rolls compared with raw rolls but changed little thereafter in storage. Cook yields were significantly higher for rolls containing added onion extracts than for controls ($P < 0.05$) but no colour differences were detected using Hunter Lab values ($P \geqslant 0.05$). A 30-member untrained sensory panel expressed no preference for freshly opened 4 day-stored control or onion extract-supplemented rolls packed in plastic casings but there was a significant preference ($P < 0.05$) for the onion extract product when 4 mm thick meat slices were stored in air for an additional 24 h.

Keywords: Onion; Quercetin; Turkey breast; Lipid oxidation; Flavour

1. Introduction

Flavour in cooked meats is a key attribute of quality and its retention during storage is of considerable importance to producers of commercially prepared meat products. However, without protection, the flavour of cooked meats deteriorates quite rapidly during storage or on reheating (Tims & Watts, 1958) due to a process of free radical-induced oxidation of intramuscular membrane phospholipids, which contain relatively high levels of polyunsaturated fatty acids. The retention of fresh flavour in cooked poultry meats, in particular turkey, is rather problematic and it has been shown that the high concentrations of oxidatively labile phospholipids in turkey breast muscle make it more susceptible to oxidative deterioration than other meats (Allen & Foegeding, 1981; Wu & Sheldon, 1988).

A wide range of methods has been used to counteract the effects of lipid oxidation on the quality of stored turkey products. These include: (a) increasing the concentration of the endogenous natural antioxidant, α-tocopherol, in muscle, by pre-slaughter dietary supplementation with synthetic α-tocopherol acetate (Ahn, Sell, Chen, Wu, & Lee, 1998; Brunn-Jensen, Skovgaard, Skibsted, & Bertelesen, 1994); (b) restricting the access of oxygen to cooked meats during storage with the aid of vacuum or modified atmosphere packaging (Jones, Mead, Griffiths, & Adams, 1982; Nolan, Bowers, & Kropf, 1989); and (c) using approved synthetic phenolic antioxidants, such as BHA, which are efficient free radical-scavengers (Hsieh & Kinsella, 1989). However, negative trends in consumer perceptions of synthetic food additives and an increased use of more 'natural' ingredients in foods have led to a growing interest in the use of natural antioxidants as potential inhibitors of lipid oxidation in cooked meats (Shahidi, 2000). For example, it has been shown that rosemary extracts are effective in reducing oxidation in cooked pork

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(MacCarthy, Kerry, Kerry, Lynch, & Buckley, 2001), beef, and turkey meat (Barbut, Joesephson, & Maurer, 1985).

Phenolic compounds with strong antioxidant properties are prominent components of many food plants, including aromatic plants such as onion and garlic which are used to enhance the sensory quality of foods. However, for reasons of sensory compatibility, only some of the latter are suitable for general use with meat- and fish-based products. Onion (*Allium cepa* L.) is the most important of these and is much valued for the manner in which its flavouring components complement and enhance the flavour of most meat dishes. In addition, onion has been found to have the highest quercetin content (284–486 mg/kg) in a survey of 28 vegetables and nine fruits (Hertog, Hollman, & Katan, 1992a). Quercetin a flavonol along with flavones, isoflavones, anthocyanins and the flavan-3-ol derivatives, including cathecins and tannins, constitute a highly ubiquitous group of plant phenolics known as the flavonoids. It has been estimated that onions provide as much as 29% of the antioxidant flavonoids in the Dutch diet (Hollman, Feskends, & Katan, 1999). Quercetin is included in a list of 28 plant-derived compounds which are either accepted or purported nutraceuticals (Wildman, 2001) and an increasing volume of research during the past decade has provided growing evidence that flavonoids from plant foodstuffs may play an important role in the prevention of coronary heart disease and certain forms of cancer (Yang, Landau, Huang, & Newmark, 2001). Neuhouser (2004) recently reviewed data from four cohort and six case control human population studies, and concluded that flavonoids, in particular quercetin, may reduce the risk of lung cancer. The in vivo bioactivity of quercetin is related to its bioavailability which varies widely between foods and appears to depend on the nature of the glycosylated forms present. For example, quercetin in onions occurs mainly as a mixture of the 4′-monoglucoside and 3,4′-diglucoside and a number of studies indicate that these have a much greater bioavailability than quercetin from other food sources containing different sugar moieties (Arts, Sesink, Faassen-Peters, & Hollman, 2004; Hollman et al., 1997). In addition, Walle, Otake, Walle, and Wilson (2000) have shown that both glucosides are efficiently hydrolysed in the small intestine by β-glucosidases to quercetin, most of which is then absorbed.

In the *Allium* family of aromatic plants, the precursors of aroma are non-volatile akyl and alkenyl cysteine sulphoxides with propyl and propenyl being the dominant moieties in onion (Freeman & Whenham, 1975). Raw onion aroma is produced by enzymatic degradation of the sulphoxides while sulphur compounds contributing to cooked onion flavour are produced by heating, which produces relatively complex mixtures of symmetrical and unsymmetrical disulphides and some trisulphides (Schulz, Krüger, Liebmann, & Peterka, 1998).

Investigations on possible interactions between meats and onion extracts, which might lead to preservation/enhancement of flavour in the former, have been very few to date. Two studies have shown that water-extracted onion juices could control rancidity in cooked ground turkey (Younathan, Marjan, & Arshad, 1980) and in cooked ground lamb (Jurdi-Haldeman, Macneil, & Yared, 1987). Chemical indices of lipid oxidation were shown to be much reduced relative to a control in stored cooked dark chicken meat which had been mixed with freeze-dried onion powder prior to cooking (Karastogiannidou, 1999). The latter is the only report study to date on a meat product, which also related quercetin concentration in the onions to the magnitude of the antioxidant effect. Some recent (unpublished) work in the present authors' laboratory has shown that oven-cooked turkey breast, which had been marinaded overnight in cooked onion juice, oxidised more slowly during storage than an untreated control, and also had a much superior sensory quality after storage for 6 days at 5 °C.

A wide range of sliced meat products is sold at the cold meat counters in modern retail outlets. Many of these are produced in the form of small or large diameter encased meat rolls, which are steam- or immersion-cooked, and include ham, pork, beef and poultry products. As well as the more highly comminuted pudding and luncheon roll formulations, which contain significant amounts of non-meat ingredients, this group includes a range of more expensive whole meat products prepared using proprietary added brines.

The overall aim of the present study was to evaluate the feasibility of producing a premium quality turkey breast roll product incorporating a purely natural flavour-preserving/enhancing ingredient, prepared by tumbling the raw meat with a brine made from a concentrated cooked onion extract. Because the quantity of the brine liquor taken into the meat was controllable, so also was the amount of quercetin, the main antioxidant component of the juice. Therefore, four specific objectives of the work were: (a) to optimize the extraction conditions for quercetin from onion, (b) to evaluate the effectiveness of quercetin in controlling the development of lipid oxidation during refrigerated storage of the cooked meat, (c) to measure changes in quercetin levels resulting from cooking and storage of the rolls, and (d) to compare the sensory quality of stored onion juice-treated meat with a control meat not containing this flavouring ingredient.

2. Materials and methods

2.1. Extraction of onion juice

Yellow-skinned cooking onions were purchased from a local retail outlet. The onion juice was prepared by adding 500 g of finely chopped onion to 500 ml of distilled water which had been preheated to 90 °C. Heating at this temperature with occasional stirring was carried out in separate experiments for periods of 10, 20, 30, 40, 50 or 60 min to optimize the extraction time. After cooling to room temperature, the mixtures were homogenised in a Waring Commercial Blender (Model 32BL80, Dynamics

Corporation of America, USA) and subsequently centrifuged at 10,000 rpm for 20 min in a high speed centrifuge (Model J2-HS, Beckman, USA). Quercetin measurement was carried out on the freshly prepared juice while the remainder was stored at −20 °C until required.

2.2. Manufacture and cooking of turkey rolls

Turkey breast meat purchased from a local producer was trimmed of visible fat and connective tissues immediately on delivery, vacuum-packaged (Webomatic packaging system, Model No. 021ODC681, Webomatic, Bochum, Germany) in polyethylene bags and frozen. When required for product manufacture, the meat was removed from the freezer, thawed overnight in a refrigerated room at 4 °C and then ground through a 4.5 mm plate using a meat mincer (Model No. TS 8E, OMAS Food Machinery, 21040 Oggiona S. Stefano, Italy). Brines were prepared by dissolving sodium chloride in water or in onion juice solutions, mixed with the raw muscle to give a final salt concentration of 1.2% (w/w), after which the brined meat was tumbled at 4 °C for 3 h using a vacuum tumbler (Model No. MC-25, Inject Star of the Americas, Inc., Brookfield CT, USA). The meat emulsion was then filled into either 35 mm or 96 mm diameter plastic casings (Walsrode K-Plus, Casetech, GmbH, Germany) using a mechanical filler (Model No. EM-12, Equipaimentos Carnicos, Barcelona, Spain) and sealed with plastic ties (Maplin electronics, Dublin, Ireland) to make either small (length, 80 mm) 100 g rolls or large commercial sized (length, 160 mm) 1 kg rolls. For both diameter rolls, three turkey breast products were prepared by incorporating 10% (w/w) of added brine, consisting of an aqueous control brine (CL), a 25% strength onion juice brine (OJ25), or a 50% strength onion juice brine (OJ50).

The turkey rolls were cooked in a thermostatically controlled KERRES smoke-air steam oven (Type CS 350, Raicher-und-Kochanlagen, D-71560 Sulzbach-Murr, Germany) set at 80 °C. Cooking times for small and large rolls were 30 and 150 min, respectively. After cooking, rolls were cooled under running cold water for 1 h and then in a 5 °C cold room for 2 h prior to measuring the yield and carrying out further evaluation.

In this study, the yield is defined as the ratio of the cooked weight of the meat roll to the raw turkey meat weight (expressed as %). Reported data points in Figs. 1–3 and in Table 1 represent the means from duplicated cooking and storage experiments.

2.3. HPLC analysis of quercetin levels in onion juice and meat

A modified version of the HPLC procedure of Hertog, Hollman, and Venema (1992b) was used to measure the quercetin contents in fresh onions, cooked onion juices and in turkey breast meat with added onion juice. Free quercetin aglycone was measured by a reverse phase HPLC method after liberating it from its glycosylated forms by hydrolysis with acidified methanol.

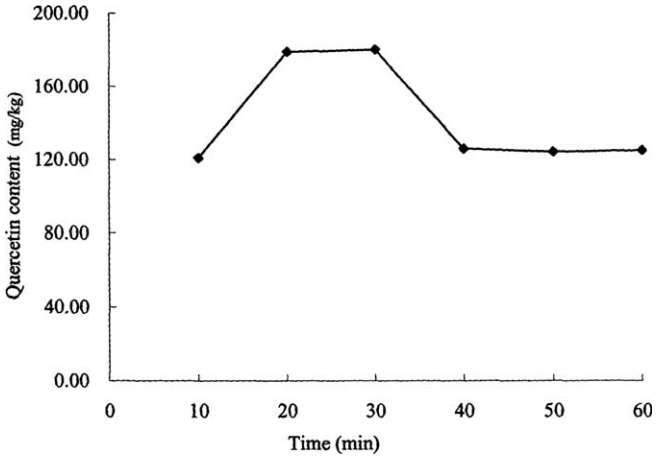

Fig. 1. Effect of heating time on total quercetin content of water-extracted onion juice.

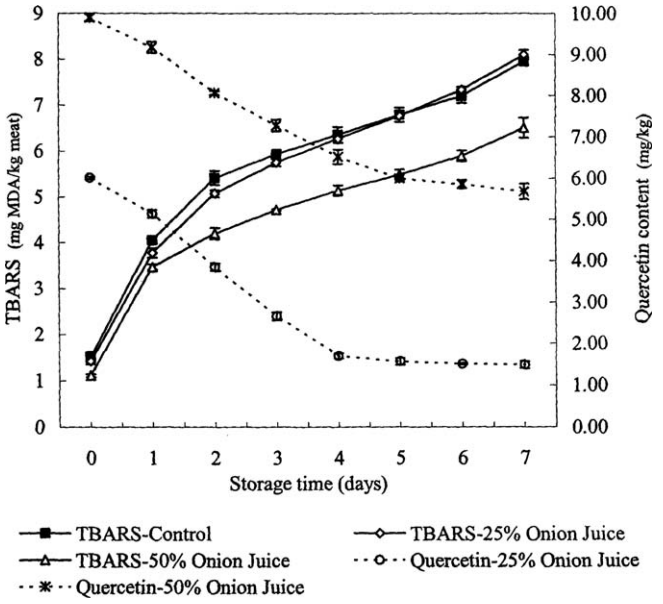

Fig. 2. Development of lipid oxidation and changes in quercetin concentration in small (100 g) turkey rolls during storage at 5 °C.

Onion juice (5 ml) was added to 90 ml of 1.2 M HCl in 50% aqueous methanol in a 250 ml amber glass bottle and heated at 80 °C in a water bath for 2 h. After cooling, the samples were diluted to exactly 100 ml with the acidified methanol and filtered through a Whatman No. 1 filter paper. The filtrate obtained after a second filtration through a 0.2 μm membrane filter (Gelman Sciences Inc., USA) was directly injected onto the HPLC column for quercetin analysis. To analyse the quercetin content in fresh onion and cooked turkey meat, finely chopped samples (5 g) were homogenised for 1 min at 9000 rpm using an Ultra Turrax T25 homogeniser (Janke and Kunkel, IKA-Labortechnik GmbH, Germany) in 90 ml of 1.2 M

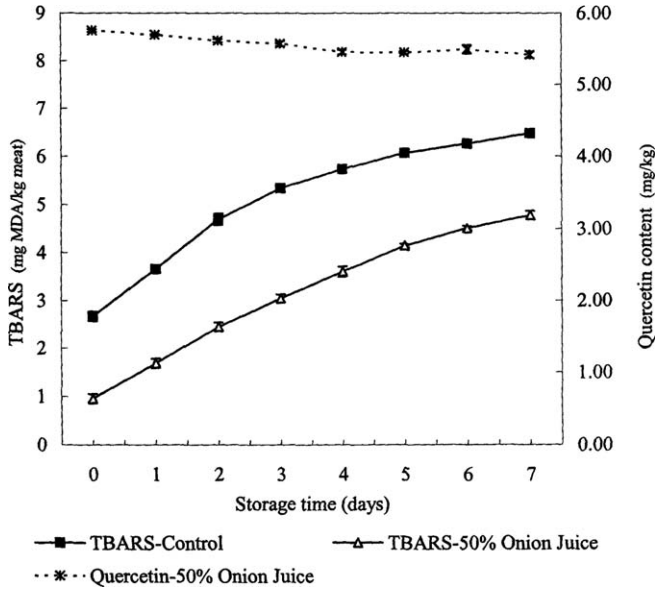

Fig. 3. Development of lipid oxidation and changes in quercetin concentration in commercial size (1 kg) turkey rolls during storage at 5 °C.

Table 1
Mean internal colour parameters and yields of cooked 1 kg control (CL) and 50% strength onion juice (OJ50)-supplemented turkey rolls

Type	Hunter *L*	Hunter *a*	Hunter *b*	Yield (%)
Control	72.98 ± 0.09^{a}	3.55 ± 0.08^{a}	8.56 ± 0.14^{a}	106.07 ± 0.24^{a}
Onion added	73.19 ± 0.15^{a}	3.43 ± 0.09^{a}	8.68 ± 0.09^{a}	107.16 ± 0.08^{b}

[a,b] Means with different letters in a column are significantly different ($P < 0.05$).

HCl in 50% aqueous methanol and treated as described for the onion juice.

HPLC analysis was carried out on a Spectra Physics HPLC system (Thermo Separation Products Inc., Riviera Beach, FL 33419-9967, USA) consisting of a Spectra SYSTEM P2000 pump, a SpectraSYSTEM UV1000 ultraviolet detector set at 370 nm and a ChromJet computing integrator. A 100 mm × 3 mm i.d. reversed phase column (Inertsil 5 ODS-2, Chrompack, UK) was used for the measurement of quercetin, which had a retention time of 8.3 min, using 50% methanol in 0.5% aqueous orthophosphoric acid at a flow rate of 0.4 ml/min as the mobile phase.

A stock solution was prepared by dissolving 0.050 g of quercetin dihydrate (Sigma–Aldrich) in 100 ml of HPLC grade methanol and was used to prepare a series of calibration standards in the range 0.25–2.5 μg/ml by dilution with 1.2 M HCl in 50% aqueous methanol. A calibration curve (peak area vs. concentration) prepared with these standards showed excellent linearity ($R^2 = 0.9995$).

2.4. Measurement of lipid oxidation

Lipid oxidation in cooked turkey rolls was monitored immediately after cooling to the holding temperature of 5 °C and on a daily basis during storage for up to 7 days at this temperature. Unless otherwise stated, the cooled rolls were removed from their casings and stored under aerobic conditions in unsealed polythene bags. The 2-thiobarbituric acid (TBA) procedure of Siu and Draper (1978) was used for the assay and results were expressed as thiobarbituric acid-reactive substances (TBARS) in mg of malondialdehyde (MDA)/kg muscle.

2.5. Instrumental colour measurement

Instrumental colour measurement was carried out on the internal surfaces of freshly cooked and cooled large (1 kg) rolls by slicing the latter at a distance of 5 cm from one end of a roll and covering the cut surface with stretchable transparent polythene film. A Minolta colorimeter (Model No. CR-300, Minolta Ltd., Milton Keynes, UK) was used to determine Hunter *L* (lightness), *a* (redness/greenness) and *b* (yellowness/blueness). The colorimeter was calibrated for internal light (D65) before carrying out colour measurements.

2.6. Sensory evaluation

Sensory evaluation, using a preference test, was carried out on 4 mm thick slices of 4 and 5 day-stored control and 50% strength onion juice-treated commercial sized (1 kg) turkey rolls. The 4 day-stored samples were removed from the casing and freshly sliced on the day of sensory evaluation while, for the 5 day-stored meat, removal of the casing and slicing of the samples were carried out 24 h prior to the sensory analysis in order to stimulate lipid oxidation. 30 untrained panellists were recruited to carry out the test in a sensory analysis laboratory equipped with individual tasting booths and controlled lighting. In the preference test, each panellist was asked to select their preferred sample from two coded slices presented, based on the overall flavour of the meats. The results of the preference evaluation experiment were analysed by a binomial test, as described by O'Mahony (1986).

2.7. Statistical analysis

The results of instrumental colour, yield and lipid oxidation were analysed using the Statistical Analysis System (Version 8.2, Statistical Analysis Systems, Cary, NC, USA). A *t* test was used to determine significant differences between the means.

3. Results and discussion

3.1. Effect of heating time on quercetin content of water-extracted onion juice

The relationship between total quercetin levels in hot water extracts of onion juice and heating time is presented in Fig. 1. It shows that the highest yield of quercetin at 180 ± 2.15 mg/kg of juice was achieved after extraction

for 20–30 min at 90 °C with losses of around 30% occurring between 30 and 40 min and with little further loss thereafter. Extraction times of less than 20 min were obviously insufficient for effective recovery of the flavonol glucosides. While more severe extraction conditions, such as boiling, were avoided in the present study in order to minimise losses of desirable volatile aroma compounds, it has also been shown that boiling of onions can lead to some losses of quercetin which are time-dependent (Hirota, Shimoda, & Takahama, 1998). Overall, the extraction efficiency of quercetin under optimum conditions was of the order of 90% since the level in the fresh onion flesh was found to be 398 ± 2.8 mg/kg and the juice was prepared by extracting the chopped onions with an equal weight of water. Free quercetin was almost absent from the extracts with the concentration of the aglycone in the 50% juice amounting to only 0.37 mg/kg. Published data on quercetin levels in onions indicate a very high degree of variation. For example, Patil, Pike, and Yoo (1995) found a quercetin range of 0.21–286 mg/kg across 75 cultivars grown in Texas in 1992 with white varieties showing the lowest levels. Yang, Meyers, van der Heide, and Liu (2004) found that total flavonoids (comprising 80–90% quercetin) ranged from 58 to 692 mg/kg in 10 varieties grown in seven geographical locations as far apart as New York and Peru. By contrast, Price and Rhodes (1997) reported total quercetin levels of 1778, 1516 and 1369 mg/kg in three English varieties comprising red-, brown- and pink-skinned types, respectively. On the basis of the latter data, the onion variety used in the present study was a relatively poor source of quercetin, but was good in the context of levels cited in the American studies.

3.2. Development of lipid oxidation and changes of quercetin levels in turkey breast rolls during chilled storage

In this study, the development of lipid oxidation and changes of quercetin contents of both small (100 g) and large commercial sized (1 kg) turkey rolls were monitored during storage at 5 °C. The small rolls were convenient and quick to prepare in relatively large numbers for preliminary experiments, where the effects of different juice compositions on quality aspects of the stored cooked meats were assessed.

Fig. 2 shows the development of lipid oxidation and the changes in quercetin levels in 100 g turkey rolls containing 10% (w/w) added brines, which included an aqueous control (CL), a 25% onion juice brine (OJ25) and a 50% onion juice brine (OJ50). As shown in the figure, the rate of lipid oxidation, in all three products, was quite rapid during the first 2 days of storage and decreased somewhat thereafter. The influence of the strength of the onion juice in the brine was quite marked after day 2, where the control and OJ25 brined meats oxidised at a similar rate while the TBARS values of the OJ50 meat increased at a significantly lower ($P < 0.0001$), but still relatively rapid, rate.

The calculated quercetin contents of the OJ25 and OJ50 turkey rolls were 8.17 and 16.3 mg/kg, respectively. After cooking (30 min) and cooling to 5 °C, the quercetin contents had dropped by 24% to 6.01 mg/kg for OJ25 and by 38% to 9.89 mg/kg for OJ50. Moreover, as shown in Fig. 2 the quercetin level in the OJ25 roll continued to decline significantly during storage to a value of only 1.49 mg/kg by day 7, while the corresponding level in the OJ50 rolls was much higher at 5.68 mg/kg. This result suggests that the starting quercetin concentrations present in the OJ25 rolls were simply too low to exert any control on the subsequent development of lipid oxidation during storage, as indicated in Fig. 2.

Previous work with cooked turkey breast has shown that it is most susceptible to the initiation of lipid oxidation directly after cooking while still hot, and that techniques such as hot vacuum-packaging (Ahn, Ajuyah, Wolfe, & Sim, 1992) or cooling under nitrogen (Brunton, Cronin, & Monahan, 2002) are very effective in slowing the subsequent rate of lipid oxidation during storage. To further examine the relationship between quercetin levels in the brined turkey rolls and the TBARS data during storage, a simple experiment was carried out, in which a number rolls containing 50% onion juice were either vacuum-packed immediately on removal from the steam oven or were allowed to cool in air. The latter sample served as the control. After storing unopened at 5 °C for 6 days the vacuum-packed meat had a mean TBARS value of only 0.81 mg MDA/kg, indicating minimal lipid oxidation. In addition, the quercetin level of the meat was 14.3 mg/kg which was only 12.4% lower than the theoretical value. The TBARS value for the control rolls (1.62 mg MDA/kg) was approximately double that of the vacuum-packed rolls but was still relatively low, possibly due to a combination of the antioxidant effect of the quercetin and the fact that the rolls remained sealed within their casings for the duration of storage. While not impermeable to air, we have observed that certain plastics used as meat casings appear to provide some degree of protection against lipid oxidation during storage (unpublished work). The level of quercetin in the control meat (8.92 mg/kg) was 37.5% lower than in the vacuum-treated rolls.

While the production of an antioxidant effect by the flavonoid components of the added onion juice was obviously a positive effect, the broader influence of the juice on the overall sensory quality of the cooked turkey breast may well be of greater importance in terms of its potential to yield a commercial product with superior shelf life and improved sensory attributes. Preliminary tasting experiments on the 100 g rolls, using an informal 5-member panel, did in fact suggest that the onion juice had a positive effect on the flavour of the meat, with all tasters expressing a preference for both the OJ25 and OJ50 formulated meats over the controls in freshly cooked meat. These findings therefore encouraged us to prepare and cook semi-commercial-sized (1 kg) control and onion juice (OJ50)-supplemented turkey rolls, to measure both

TBARS values and quercetin concentrations during storage and to carry out a more rigorous sensory assessment.

The development of lipid oxidation during refrigerated storage, as well as changes in the quercetin status of 1 kg cooked turkey rolls, is presented in Fig. 3. Initial TBARS values for the controls (CL) were approximately 2.8 times higher than those of the onion juice-treated meat and were also much higher than initial levels in the 100 g control rolls (Fig. 2). While lipid oxidation was not particularly rapid in either the CL or OJ50 rolls, it was maintained consistently lower during storage in the latter, reaching a level of only 4.78 mg MDA/kg compared to 6.48 mg MDA/kg in the control after 7 days. TBARS data for CL and OJ50 rolls were in fact significantly different ($P < 0.0001$) for each of the eight assays carried out per storage experiment. The quercetin content of the freshly cooked OJ50 meat (5.76 mg/kg) was also substantially lower than that in the corresponding 100 g rolls (9.89 mg/kg), but only decreased by 0.34 mg/kg over 7 days of storage. One major difference between the large and small rolls was the cooking time which was 150 min for the former and 30 min for the latter. We have recently shown that thermal damage to the outer (surface) layers of steam-cooked large diameter encased turkey breast rolls makes them more susceptible to lipid oxidation during storage and this was manifested in much higher initial TBARS values for the outer compared to the inner layers of the rolls (Tang, Cronin, & Brunton, 2005). This is almost certainly the reason for the higher initial TBARS values of the control samples compared to those containing onion juice in the present work. This would also explain why a higher antioxidant demand in the more heat-damaged large rolls would result in lower initial quercetin levels therein compared to the less heat-damaged 100 g rolls.

3.3. Instrumental colour and yield

The results of instrumental colour measurements on the 1 kg control and OJ50 turkey rolls are presented in Table 1. Although the onion juice had a slightly yellow colour, it did not appear to affect the colour of the cooked products. No significant difference was found between any of the measured instrumental colour parameters, including Hunter L, a and b values of control and onion juice-supplemented turkey rolls ($P \geqslant 0.05$). The total yield, as defined in Section 2.2, is also presented in Table 1 and shows that the onion juice-containing rolls had significantly higher yields than control samples ($P < 0.05$). This suggested the possible presence in onion juice of components with some water-holding capacity, which might enhance retention of the added fluid within the product during cooking and result in a higher overall yield. Although onions are almost totally lacking in starch they do contain significant levels of soluble carbohydrates, in particular fructans (Brewster, 1994), and these would be the constituents of onion juice most likely to facilitate increased retention of moisture within the cooked meat.

3.4. Sensory evaluation

Preference tests, using an untrained 30-member taste panel, were carried out as described in Section 2.6, on 4 mm thick slices of the 1 kg turkey rolls, to determine whether or not panel members had a preference for an aqueous brine control meat or for turkey breast prepared using a 50% strength onion juice brine (OJ50). The panel first evaluated sliced meat from freshly opened rolls which had been stored for 4 days at 5 °C and no preference for either meat was expressed with exactly half the tasters (15) opting for each sample. Sliced meats from this experiment were stored for at 5 °C for 24 h and again subjected to panel evaluation. In this case 21 out of 30 panellists expressed a preference for the onion juice-treated turkey rolls, based on the overall flavour of the samples. Statistically, this indicated a significant preference ($P < 0.05$) for the onion extract-supplemented turkey rolls over the controls (O'Mahony, 1986). The panellists used such terms as 'bland', 'rancid', 'less meaty' to describe the control samples while the flavours of the OJ50 rolls were described as 'fresh', 'strong', 'superior', and 'much meatier'. Turkey breast in sliced form, with a high surface area exposed to air, is particularly susceptible to lipid oxidation and Brunton et al. (2002) have noted that flavour deterioration is a more serious problem with the more expensive minimally processed or 'turkey on the bone' type products than with their more heavily processed counterparts. The results of the present study suggest that the incorporation of onion juice during the preparation of encased turkey breast rolls leads to the production of a premium quality product possessing improved flavour quality and stability in sliced form. The onion juice probably exerts its beneficial effect by a combination of its antioxidant properties and a masking of off – flavours in the meat by certain cooked onion flavour compounds which are compatible with cooked turkey flavour.

4. Conclusion

This study has shown that it is possible to incorporate the natural antioxidant and nutraceutical quercetin in a controllable manner in turkey breast rolls using brines made from aqueous cooked onion juice extracts. Juice from an onion variety with a moderately high quercetin level, provided a significant antioxidant effect during cooking and storage of the cooked meat, while the additional positive – and perhaps decisive – contribution of the onion flavour compounds yielded a sliced product of superior sensory quality to a brined control meat not containing the onion juice. It may be possible to further enhance the antioxidant role of quercetin by using a juice from a high quercetin-yielding onion variety.

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