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LIPID OXIDATION, SENSORY AND MICROBIAL PROPERTIES OF GROUND PORK DURING STORAGE AS AFFECTED BY MAILLARD REACTION PRODUCTS FROM WHEAT PROTEIN HYDROLYSATE AND SUGARS

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Introduction:

Many researches have reported antioxidative properties of Maillard reaction products (MRP) in a model systems (Kato, 1973; Itoh et al., 1975; Lingnert and Ericksson, 1981), but only a few studies had been conducted in food systems. Bailey et al. (1987) reported that MRP mixture of glucose and histidine was effective in preventing lipid oxidation in cooked ground beef patties. Rancidity development in frozen sausage was retarded with a MRP from glucose and histidine (Lingnert and Lundgren,1980). Smith and Alfawaz (1995) prepared MRP by autoclaving egg albumin acid hydrolysate and glucose for 1 hr and added MRP to ground beef which was cooked and stored for 8 days. They found TBA values decreased by 17% with the addition of 0.5% MRP and by 39% with 1% MRP over storage time.

Objectives :

Maillard reaction products (MRP) preparation:

The MRP were prepared by refluxing 2 g of freeze-dried wheat protein hydrolysate with 2 g of each reducing sugar in 25 mL distilled water. The pH of MRP mixture was adjusted to 9.0 using 1N NaOH and then was refluxed at 100℃ for 20 hr (determined by the results of a pre-experiment) in a 250 mL flask coupled to a reflux condenser. The condensed MPR mixtures were covered and stored in a cooler at 1℃ until used.

Antioxidative activity (AOA) test method and Ferric thiocyanate test method:

The AOA test was determined by the method described by Lingnert and Erikson (1980). Antioxidative activity of MRP in linoleic acid /methanol (0.13 : 10, v/v) solution was determined according to the modified ferric thiocyanate test method (Mitsuda et al., 1967).

Results and Discussions:

TBA values (Fig. 1) for the wheat protein hydrolysate-DHA group were lower than the controls ($p<0.05$), and wheat protein hydrolysate-glucose ($p>0.05$), and wheat proteinhydrolysate-xylose ($p>0.05$) treatments. This indicated that MRP from wheat protein hydrolysate-DHA had superior antioxidant activity in preventing lipid oxidation in fresh ground pork. In general, the TBA values for the controls were slightly higher than all wheat protein hydrolysate-sugars combinations over storage time. Lingnert and Eriksson (1980) reported xylose-arginine MRP had the strongest antioxidant activity of all MRP tested. Bedinghaus and Ockerman (1995) found the xylose-tryptophan treatment had the lowest level of lipid oxidation among all xylose-MRP treatments and the contols. Since we used wheat protein hydrolysate instead of amino acids in this study; therefore, our results could not be comparable to those results.

In the antioxidative activity (AOA) method, the higher the AOA scores, the better the antioxidative effect of MRP (Fig. 2). Theoretically, the maximum AOA test score is 1.0; if MRP had no antioxidant activity, the scores will be near 0. Wheat protein hydrolysate -DHA and wheat protein hydrolysate-glucose MRP treatments were found to be more effective ($p<0.05$) in preventing lipid oxidation in linoleic acid emulsion than wheat protein hydrolysate-xylose treatment as determined by the AOA method.The AOA test values between wheat protein hydrolysate-DHA and wheat protein hydrolysate-glucose treatments were not different ($p>0.05$), suggesting their antioxidant activity in linoleic acid system was not different.

In the ferric thiocynate method test (Fig. 3), MRP was added to linoleic acid /methanol solution and incubated at 40℃ for 7 days. The lower the absorbance at 500 nm, the better the antioxidat effect. Antioxidative activity of MRP determined by this method could also be used as an indication of the effectiveness of MRP in linoleic acid systems. The results shown in Fig. 3 indicated that all MRP from sugars (glucose, xylose, and DHA) and wheat protein hydrolysate were effective inhibitors of lipid oxidation in an model system comprising linoleic acid. The most effective were wheat protein hydrolysate-DHA and wheat protein hydrolysate-glucose when compared to the controls. These results were similar to those determined by the AOA test (Fig. 2). Itoh et al. (1975) indicated DHA-leucine MRP had superior antioxidant activity in safflower oil and was more effective than butylated hydroxyanisole (BHA). Kawashima et al. (1977) found DHA-leucine MRP had excellent antioxidative effect in safflower oil.

It has been suggested that MRP has an antimicrobial effect, and that microbial growth rate is lower where MRP were present at higher concentrations (Varnam and Sutherland, 1995). Our results (Fig. 4) indicated that MRP (3%) from wheat protein hydrolysate and sugars (glucose, xylose and DHA) could only inhibit the microbial growth slightly ($p>0.05$) in fresh ground pork during storage at 1℃ for 9 days.

Sensory acceptability scores of ground pork with the addition of 3% MRP from wheat protein hydrolysate and sugars are shown in Fig. 5. MRP were added to fresh ground pork patties and PE-packaged, stored at 1℃ for 3 days, then cooked to an internal temperture 85

℃ for the sensory evaluation. All sugars (glucose, xylose and DHA) with wheat protein hydrolysate MRP treatments had higher ($p<0.05$) sensory acceptability scores than the controls.

Conclusions:

MRP from wheat protein hydrolysate and sugars (glucose, xylose and DHA) exhibited very good antioxidative effects in fresh ground pork (25% fat) and in linoleic acid systems determined by the TBA, AOA and ferric thiocynate methods. The most effective MRP were wheat protein hrydrolysate-DHA and wheat protein hydrolysate-glucose tested by all 3 methods used in this study. Sensory flavor, color and acceptability scores of ground pork patties (stored at 1℃ for 3 days and cooked to an internal temperature 85℃) were significantly ($P<0.05$) improved by the addition of 3% MRP from wheat protein hydrolysate and sugars (glucose, xylose and DHA) when compared to the controls. During storage at 1℃ for 9 days, total plate counts of PE-packaged ground pork were slightly ($P>0.05$) affected by MRP (3%). It suggested that MRP probably could not inhibit the bacterial growth effectively .

References:

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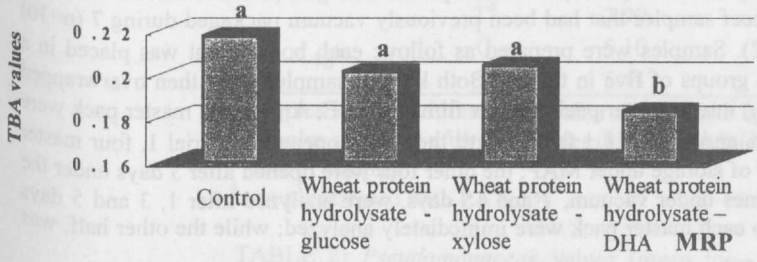

Fig. 1–Effect of Maillard reaction products (3%) from wheat protein hydrolysate and sugars on TBA values (pooled data over storage time up to 9 days at 1℃) of PE packaged ground pork (25% fat). Means with different letters are significantly different ($P < 0.05$).

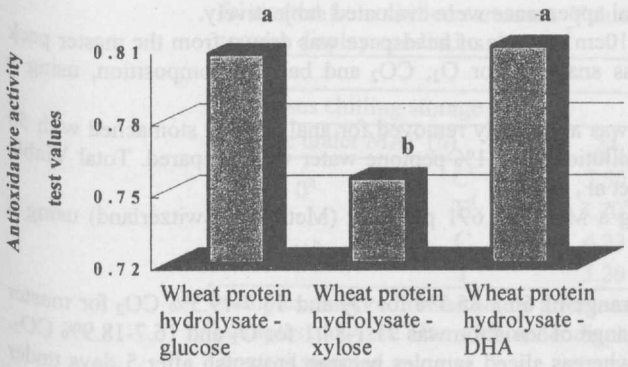

Fig. 2–Antioxidative activity test values in linolenic acid emulsion as affected by Maillard reaction products from wheat protein hydrolysate and sugars.

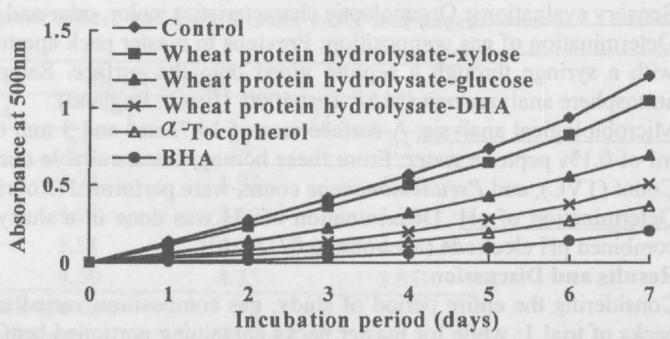

Fig. 3–Antioxidative activity of Maillard reaction products from wheat protein hydrolysate and sugars determined by the ferric thiocyanate method.

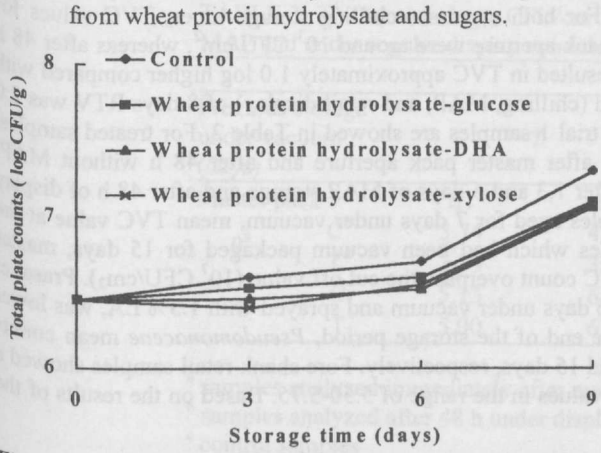

Fig. 4–Effect of MRP from wheat protein hydrolysate and sugars on total plate counts of fresh ground pork .

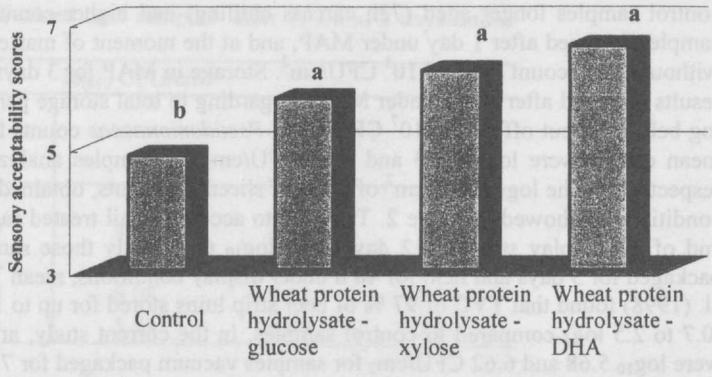

Fig. 5–Sensory acceptability scores of ground pork (PE packaged and stored at 1℃ for 3 days) as affected by Maillard reaction products (3%) from wheat protein hydrolysate and sugars. 1=extremely dislike ; 9=extremely like .