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Formation of Meat like Flavor

Cheng-Chang Lin
Department of Hospitality, Diwan College of Management, 87-1, Nanshi Li,
Madou Town, Tainan 72153, Taiwan, ROC

Abstract: Maillard reaction was evaluated the capable procession for producing the meat like flavor using for vegetarianism food. Yeast extract powder was used the basement mixing with cysteine and methionine to reflux react with glucose at 80°C for 2 h. The proper reaction parameters to form meat like flavor were pH concentration of the reagents 0.3 M.

Key words: Maillard reactio, meat like flavor, yeast extract

INTRODUCTION

Maillard reaction was known as a complex chain reactions leading to the formation of a various compounds including the flavors, aromas and colors considered important in food science today. The Maillard reaction was reaction of reducing sugars with amino acids to produce flavor and color. The mechanism of the Maillard reaction was shown three stages (Lee, 1983; Mauron, 1981). The first stage involved the sugar-amine condensation and the Amadori rearrangement. The second stage involved sugar dehydration and fragmentation and amino acid degradation via the Strecker reaction especially at high temperatures beginning to form flavor. Formation of heterocyclic nitrogen compounds and browning (Davies and Labuza, 1992, 1994).

Heating cysteine with ribose, glucose or xylose produced a flavor and aroma of meat (Morton *et al*., 1960). Cysteine was used as precursor for the development of meat flavor in many of the patents (May, 1961; May and Morton, 1956; Pfizer and Co Inc, 1965; May and Soeters, 1966; Giacino, 1968; Broderick and Marcus, 1970). The reaction between ribose and cysteine yielded 2-methyl-3-furanthiol was the most important compound in chicken flavor (Ohloff *et al*., 1985). The reaction of cysteine and sugar was important for formation of meat like flavor especially for chicken and pork (MacLeod and Seyyedain-Ardebili, 1981; de Roos, 1992).

This study evaluated the capable procession for producing the meat like flavor as beef or pork using for vegetarianism food. The influence of reaction parameters as pH, concentration of the reagents and types was discussed by spectrophotometer. Sensory evaluation was used for acceptance scores of meat flavor samples.

MATERIALS AND METHODS

Materials: Beer yeast powder (Qingdao Century-Light Industry Co., Ltd. China) contained protein 45%, moisture 10% and ash content 9%.

Yeast extract powder: The solution of 30% (w/w) yeast powder was adjusted by 1 M HCl at pH 4.0 and then autolyzed at 40°C for 24 h. The autolyzed solution was heated at 85°C for 10 min to deactivate the enzyme and then it was centrifuged at 4500 rpm for 10 min (Varavinit *et al*., 2000). The bitter compounds and beer flavor in yeast extract solution was removed by adding activated carbon 3.5 g 100 mL^{-1} of yeast extract solution and stirring at 50°C for 1 h. The activated carbon was then removed by centrifugation at 4500 rpm for 10 min. The clear supernatant was used as yeast extract and freeze dried as powder. Protein content was determined by the Kjeldahl method. Fat, ash and moisture contents were analyzed according to procedure described in the AOAC manual.

Effect of pH on melanoidin concentration: The mixture formulations and refluxing times used for the Maillard reaction to prepare meat like flavors. Yeast extract 20% mixed with 0.3 M glucose and 0.3 M cysteine or methionine. Comparison pH at 5 and 8 refluxed at 80°C for 0~2.5 h. Melanoidin concentration was examined with spectrophotometer at 420 nm (Brands *et al*., 2002).

Effect of amino acid concentration on melanoidin concentration: Comparison cysteine and methionine concentration from 0.1~0.5 M separately mixed with yeast extract 20% and 0.3 M glucose with pH 8 refluxed at 80°C for 0~2.5 h. Melanoidin concentration was examined with spectrophotometer at 420 nm.

Formation of meat like flavors: Meat like flavor was prepared with yeast extract 20%, pH 8, 0.3 M glucose, 0.3 M cysteine or 0.3 M methionine and refluxed at 80°C for 2 h.

Sensory evaluation: The flavors were evaluated for sensory acceptability by 10 trained panelists who were highly trained flavor descriptive attribute panel. The panelist was asked to evaluate and compare the flavor with commercial meat flavor composition flavors. A scale of 1~9 was used for sample rating where 1 is undesirable flavor and 9 is desirable flavor. The commercial chicken and pork falvor were used to compare with experiment product. An ANOVA-statistical technique was employed for comparison of the sensory evaluations.

RESULTS AND DISCUSSION

Composition analysis of yeast extract: Yeast extract from beer yeast powder autolyzed with pH 4.0 at 40° for 24 h and followed by removed the bitter compound. The dry powder was prepared to use. Composition analysis of yeast extract was composed protein 85.63%, carbohydoated 4.89% and fat 0.23% (Table 1). These three components were the main factors to affect the information of meat like flavors about Maillard reaction or non enzyme reaction. In food, Maillard reaction or non enzyme reaction is responsible for changes in color, flavor, and nutritive value (Fay Laurent and Brevard, 2002). Non-enzymatic browning reactions pathways are: Maillard reaction, lipid peroxidation, sugar-sugar caramelization and the degradation of ascorbic acid. Anyway, the chemistry of these reactions is related to the formation of dicarbonyl intermediates and subsequently to form browning and flavor compounds (Davies and Wedzicha, 1992).

Effect of pH on melanoidin concentration: The pH has a significant effect on the Maillard reaction. The Melanoidin compound was the intermediated compounds of non enzyme reaction which concentration was used to present the reaction rate. The absorbance of Melanoidin compound was 0.96 at pH 5 and 1.37 at pH 8 by spectrophotometer at 420 nm when the reaction at 2 h (Table 2 and 3). The result found mixture of yeast extract with cysteine and glucose at pH 8 have faster reacting rate than pH 5.

The formation of Amadori products (early Maillard reaction product) to the flavor and melanoidin production were described the important steps of Maillard reaction (Fay Laurent and Brevard, 2002). Evaluation of the optimum reaction conditions for production of a meat-like flavoring from enzyme-hydrolyzed vegetable protein were pH 6.99°C, reaction temperature, 1.5 h heating time of ribose and cysteine (Wu *et al*., 2000). In general, the rate and extent of browning increased with increasing pH (Wolfrom and Rooney, 1953). The reaction generally had a minimum at pH 3 (Lea and Hannan, 1949). At pH < 3 and > 9, other nonenzymic interactions (as sugar-sugar and protein-protein) competed with the Maillard reaction. Thus, the Maillard reaction had an optimum condition at pH above 7. The rate of formation of ketosamines increased with pH and acid-base catalyzed to forming Amadori products, monofructosyllysine and difructosyllysine in a glucose-lysine mixture as the pH from pH 4 to 8 (Lee and Nagy, 1983). A change in pH also leaded to a change in the mechanism of the reaction to the formation of different volatile and colored products (Kroh and Westphal, 1989). When the initial pH belowed 7, $-NH_2$ was formed $-NH_3^+$ to lose the amount of unprotonated amine appearance. Thus, the rate of the Maillard reaction was lower at lower pH. When temperature increased, the pH decreased. The pH of pure distilled water at 25°C is 7 but it drops to 6 at 100°C because of the temperature dependence of the equilibrium constant.

Table 1; Composition analysis of yeast extract

Protein(%)	Carbohydrate (%)	Fat (%)	Ash(%)	Moisture (%)
85.63	4.89	0.23	2.14	7.11

Table 2: Absorbance with spectrophotometer at 420 nm mixture yeast extract with cysteine and glucose at pH 5 and 8

	Time (h)				
pH	0.5	1.0	1.5	2.0	2.5
5	0.34	0.45	0.69	0.96	1.12
8	0.48	0.63	0.89	1.37	1.42

Table 3: Absorbance with spectrophotometer at 420 nm mixture yeast extract with methionine and glucose at pH 5 and 8

	Time (h)				
pH	0.5	1.0	1.5	2.0	2.5
5	0.31	0.42	0.57	0.86	0.97
8	0.38	0.51	0.77	1.03	1.05

Effect of amino acid concentration on melanoidin concentration: Mixture of different cysteine concentration, the absorbance of Melanoidin compound was increased with cysteine concentration (Table 4). The proper cysteine concentration was 0.3 M for the better economic ratio of production/reactant concentration. Mixture of different cysteine concentration, the absorbance of Melanoidin compound was increased with methionine concentration (Table 5). The proper methionine concentration was 0.3 M too. The effect of increasing the amino concentration showed relative greater increase in browning from 0.1~0.3 M than that of increasing from 0.3~0.5 M.

Table 4: Absorbance of different cysteine concentration with spectrophotometer at 420 nm mixture yeast extract with glucose at pH 8

	Time (h)				
Concentration	0.5	1.0	1.5	2.0	2.5
0.1	0.26	0.39	0.45	0.69	0.78
0.2	0.37	0.39	0.52	0.78	0.87
0.3	0.48	0.63	0.89	1.37	1.42
0.4	0.52	0.68	0.98	1.49	1.53
0.5	0.58	0.74	1.09	1.56	1.63

Table 5: Absorbance of different methionine concentration with spectrophotometer at 420 nm mixture yeast extract with glucose at pH 8

	Time (h)				
Concentration	0.5	1.0	1.5	2.0	2.5
0.1	0.16	0.34	0.42	0.66	0.72
0.2	0.28	0.33	0.49	0.75	0.82
0.3	0.38	0.51	0.77	1.03	1.05
0.4	0.42	0.58	0.79	1.09	1.13
0.5	0.51	0.64	0.89	1.16	1.24

Table 6: Acceptance scores of beef flavor samples

Sample	Score*±SD
Cb	6.47±1.02[a]
A1	6.73±0.82[a]

[a]:Means with different superscripts in the same column are significantly different at $p<0.05$, *: 1 is undesirable flavor and 9 is desirable flavor, Cb: commercial beef flavor

Table 7: Acceptance scores of pork flavor samples

Sample	Score*±SD
Cp	6.79±0.73[a]
A2	6.16±0.94

[a]: Means with different superscripts in the same column are significantly different at ($p<0.05$), *: 1 is undesirable flavor and 9 is desirable flavor, Cp: commercial pork flavor

Acceptance scores of meat flavor samples: The score of sensory evaluation of the experiment product flavor comparedwith commercial beef product flavor was 6.73 to 6.47 (Table 6) which was closed each other. The meat like beef flavor was produced from mixture of yeast extract, cysteine and glucose with pH 8 refluxed at 80°C for 2 h. The score of sensory evaluation of the experiment product flavor compared with commercial pork product flavor was 6.16 to 6.79 (Table 7) which the experiment product flavor was little lower. The meat like pork flavor was produced from mixture of yeast extract, methionine and glucose with pH 8 refluxed at 80°C for 2 h. Overall, both meat like beef and pork flavor are acceptable.

CONCLUSION

Yeast extract powder was used the basement mixing with cysteine and methionine to reflux react with glucose at 80°C for 2 h. The proper reaction parameters to form meat like flavor were pH 8 and concentration of the reagents 0.3 M. Maillard reaction is the capable procession for producing the meat like flavor using for vegetarianism food.

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