EFFECT OF DECANOIC ACID ON THE MUTTONY FLAVOUR OF GOAT MEAT

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SUMMARY

This paper discusses the chemical compounds which cause the muttony flavour of goat meat and provides a theoretical basis for the production of the more marketable demuttony flavour goat meat. Decanoic acid concentration was correlated with the strength of muttony flavour,which was stronger when C_6:C_8:C_{10} was 0.5:1:8. To comfirm the above results,Çdifferent concentrations of both pure decanoic acid alone and a combination of all three fatty acids together ($C_6H_{12}O_2$, $C_8H_{16}O_2$ and $C_{10}H_{20}O_2$) in a ratio of 0.5:1:8 were added to pork mince. The sausages made from the treated pork mince had a strong muttony flavour. Pickled cabbage juice 3%(v/v) added to fermented sausages made from goat mince reduced decanoic acid concentrahons by 29.81% to 33.75% and almost eliminated the muttony flavour, further indicating that decanoic Çacid is a major component of muttony flavour in goat meat.

Introduction

There is an advantage to raising goats in Shanxi Province because people in its many mountainous and hilly areas are experienced goat herders. However, due to the strong muttony flavour, many people do not like goat meat, which seriously affects the marketability of goat meat and its products. Therefore, demuttonizing the flavour of goat meat and its products has been listed as one of the most important research projects in Shanxi.

To produce demuttony goat meat products, it is important to understand the chemical compounds of muttony flavour. Since the 1970's, improved separation and analysis methods have been used to study milk compounds, especially the muttony compound of goat milk, but few researchers have reported on the muttony compounds of goat meat. The muttony flavour of goat milk was been directly related to the presence of free, short-chain fatty acids. The major compounds were found to be hexanoic acid, octanoic acid, decanoic acid and 4-ethyl-2-octenoic acid (Zhou 1986, Nagami 1983, Zhang et al. 1989). Wong et al. (1975) collected samples of goat milk and examined them for fatty acid. The muttony flavour in goat milk was shown to increase with an increase in fatty acid. Later,Baken and Staimshold (1978) positively correlated fatty acid concentration with the presence of muttony flavour in goat cheese. Koeetler and wegmiler (1985) produced a strong muttony flavour by saponifying fatty acids in goat milk, then treating the milk with a strong acid. They concluded that some materials must exist in the lipids of goat milk which are related to muttony flavour. Later, they isolated the muttony flavour compounds in goat milk by the Twitshell method and identified them as short-chain fatty acids. Other experiments have also confirmed that these muttony flavour compounds are insoluble in water. The muttony flavour in goat milk has thus been determined to result from the presence of free fatty acids.

Ashwate (1966) and Parkash et al. (1968) showed that the amount of C_6,C_8 and C_{10} goat milk was 24 times greater than that in cows' milk and that decanoic acid alone was 3.88 times greater than that in cows' milk. Zhou et al. (1984) reported identical results.It was also shown that the addition of any one of the three fatty acids to cow's milk did not produce a strong muttony flavour. Only when the acids were added in a certain ratio to cows' milk was a strong muttony flavour produces.

According to these studies of the muttony flavour in goats' milk, we hypothesized that muttony flavour in goat meat also results from the presence of fatty acids. We examined the concentrations of C_6, C_8 and C_{10} in pork and

goat meat using a modified version of the method used to examined muttony flavour in goat milk. The purpose of this study was to elucidate the effects of decanoic acid on the muttony flavour in goat meat.

Materials and Methods

1. Samples and Sources:

Goat meat was collected from local goats in Taigu county, Shanxi Province, China, and the sausages used in all experiments were made from local goat meat. Pork was purchased in Beijing.

2. Pretreatment of the Strong Alkaline Negative Ion-Exchange Resin

The Strong Alkaline Negative Ion-Exchange Resin,Type 262 was pretreated using the following procedures:

The resin was checked no Cl^- by saturated NaCl solution, washed by water, checked no Cl^- by $AgNO_3$, washed by 2-5% HCL, washed by water to pH=7, washed by 2-5% NaOH, washed by water to pH=7, and kept in methanol for further use.

3. Pretreatment of Samples

Meat samples were cut into small pieces, then minced twice in a meat mincer.

4. Extraction of Free Fatty Acids

Ether and two drops of diluted HCl were added to 50g samples in 250 ml stoppered flasks. After 30 minutes shaking, the extract in ether was poured out and centrifuged at 3000 rpm. The supernatant was dehydrated with sodium sulfate, and then added to the dried,pretreated resin which absorbed the free fatty acids. After two days, the ether was eluted from the resin and the resin was dried using N_2. Five ml methanol was added to the dried resin, the resin was shaken and approximately 0.4 mL sulphuric acid (98%) was added. After shaking for 10 muintes, the methanol was eluted from the resin into a 25 mL stoppered flask, to which was added 5 ml H_2O and 2 ml n-hexane. The extract was placed in a 10ml flask with sodium sulfate. 2μl sample was used for gas chromatography.

5. Gas Chromatography

Instrument: Shimatsu GC-7a, Japan

Detector: FID

Speed: 10 * 2

N_2 flow rate: 12 ml/ml

Column: 10% silar 7cp/chromocarb

W column temperature: The initial temperature was 45°C and was maintained for 2 minutes, then the temperature was increased by 5°C/min until 120°C was reached. This temperature was maintained for 10 minutes.

Vapour chamber temperature: 150°C

Sample: 2μl

6. Quality Analysis

We used A 15840 standard fatty acids (Kasukero Industry Company, Japan) to carry out the quality analysis from chromatography values.

7. Quantity Analysis

The area was calculated using the following formula:

$Ci = (Ai / \Sigma Ai) * 100\%$

where Ci is the percentage of i; Ai is the peak area of i and ΣAi is the total peak areas.

Results and Discussion:

To compare the proportions of three fatty acids (C_6, C_8, C_{10})in pork and goat meat, and to determine the major chemical compounds contributing to muttony flavour, we analysed several meat samples (Tables 1 and 2). We found that the ratios of C_6 and C_8 in pork and goat meat had no logical patterns, while the concentration of C_{10} had a regular pattern, a good repetition and the largest peak areas. We therefore selected decanoic acid as the peak characteristic of muttony flavour and the decanoic acid concentration as the measurement of muttony flavour.

From Table 1, it was seen that C_6, C_8 and C_{10} were present in proportions in goat meat and pork, respectively. The amount of C_{10} in goat meat was 2.58 times greater than in pork (Table 2). To test whether C_{10} concentration is correlated with the strength of muttony flavour in goat meat, we added different concentrations of pure C_{10} to the sausages made from the pork mince to confirm our experiments. The results are shown in Table 3.

All samples were heated to 50-60°C for 72 hours and then boiled

As seen in Table 3,C_{10} concentrations between 1 and 2 ppm produced only a non-specific flavour in the pork sausages. Concentrations of 3 ppm resulted in a slight muttony flavour and a non-specific flavour. There appeared muttony and rancid flavours with the addition of 4 ppm; and an obvious muttony flavour, as well as spicey and rancid flavours with the addition of 5 ppm. No muttony flavour was detectable at corcentrations of 10 ppm , but the sausages were unceceptably spicey and inedible.

Based on the results shown in Tables 2 and 3, we selected concentrations of C_{10} and added C_6:C_8:C_{10} in a ratio of 0.5:1:8 to pork mince from which we then made sausages. The effect on muttony flavour is shown in Table 4.

From Tables 3 and 4, we observed that only when the amount of C_{10} added was between 4 and 5 ppm, and the ratio of C_6:C_8:C_{10} was 0.5:1:8, did a muttony flavour in pork result.These results further confirmed that C_{10} was one of the major compounds causing of muttony flavour and only when C_6 and C_8 fatty acids were also present did an obvious muttony flavour appear.

In addition, to confirming effect of C_{10} on muttony flavour,we also innocalated pickled cabbage juice which we call "Biological Demuttonizing Product" [pH<3.7, sodium nitrate (4.5-9.5 ppm),_Š major microorganisms: *Lactobacillus Plantarum* and *Lactobacillus brevis* ($2 * 10^8$ /mL)] in a 3% soulution into goat mince, mixed well and encased in natural skin. The Sausages were roasted at 50-60°C for 72 hours and fermented for four weeks, then the relationship between "Biological Demuttonizing Product" concentration and demuttony flavour was determined. Results were analysed by t-test (see Table 5). There was no significant difference($p<0.05$) between the two test groups of treated goat sausages;However, a significant difference ($p>0.01$) existed between the two treated groups and the control and raw mince groups. When we assume that the C_{10} concentration in the raw mince was 100% of the rotal C_{10} present, the demuttony percentages in Test I and Test II were reduced by 29.81% and 33.75%, respectively. The muttony flavour was hardly detectable. Therefore, it was concluded that a relationship existed between muttony flavour and C_{10} concentration.

All samples nere roasted and fermented for 4 weeks, then boiled and tasted

We invited ten people who were are sensitive to muttony flavour to participate in a taste test to evaluate sausages treated with our Biological Demuttonizing Product.The criteria used were: texture, colour, flavour and

muttony flavour. The scordes were estimated by fuzzy mathematics (Zhang et al. 1989) and the results are shown in Figure 1.

From Figure 1, we knew that the peak areas of Test (a) were above 0.45 and the scores ranged from 81 to 90; the products' flavour was in the range of acceptability for consumption. It was possible to improve the quanlity of the products by moving the centre point of the peak area higher. The peak area of the control (b) was below 0.37 and the scores ranged from 71-80; these products were not acceptable for consumption. Using gas chromatography we identified C_{10} as the major chemical compound contributing to muttony flavour. The results also showed that palatable demuttony meat products could be obtained using Biological Demuttonizing Product.

To determine the relation between C_{10} contentration and muttony flavour intensity, we also analysed the C_{10} concentrations in different cuts of meat from a male goat. The results are shown in Table 6.

From the results in Table 6, it was seen that different C_{10} contentrations also existed in different cuts of meat from the same individual, i.e., C_{10} contentrations in the front leg> the rear leg> shoulder > belly. Zhou (1986), Zhang et al. (1989), and Ford (1977) have reported that the mature male goat secretes a strong odour from the odour base of the horns and tail, which imparts an odour to the body and the meat. We infer that this special odour would result in stronger muttony flavour when C_{10} is present. This requires further investigation.

Conclusions:

The following can be concluded from the above results:

1. Decanoic acid ($C_{10}H_{20}O_2$) is one of the major chemical compounds comtributing to muttony flavour in goat meat and the concentration or C_{10} is positively correlated with the degree of muttony flavour.

2. Pork products do not show a strong muttony flavour when only decanoic Çacid ($C_{10}H_{20}O_2$) is added, if the addition exceeds 5 ppm, the products will have an unpleasant non-specific flavour and a spicey, soapy taste.

3. Addition of hexanoic acid, octanoic acid and decanoic acid at a ratio of 1.5:1:8 to pork products can produces a strong muttony flavour and, within a certain range, the muttony flavour increases with the increasing addition of the three fatty acids.

4. It is feasible to reduce decanoic acidÇconcentrations demuttony products and abtain palatable demuttony products by using "Biological Demuttonizing Product" which appears to have no adverse effect on the meat.

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