# PREPARATION OF FERMENTED SAUSAGE BY LACTOBACILLUS

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1. Summary:

The fermented mutton sausage preparared in this experiment was used lactobacillus as the fermenting agent artificially inoculated into the sausage raw metarial. After homogenizing, it was put into natural casing, toasted in 40--60℃ for 2.5--3 hours, dried in the air (13--17℃) for 15--20 days. Using the enzymes released by microoganism in their metabolic processes, the substances causing odd smell in mutton were decomposed or changed into other fotms so that we can get rid of the odd smell in the sausage.

II. Introduction

Mutton has high value of nutrition as well as its tonic effect. But mutton, especially goat mutton has a strong smell so that many people do not like it. To develop mutton products, we carried out research work of preparing fermented sausage by lactobacillus.

It has been investigated that the odd smell in mutton is due to some low carbon chain free fatty acids, like caproic acid, caprylic acid, capric acid etc. These fatty acid mixing in certain propotion, are making some complex compounds, which make the smell. A male goat adipose gland can produce and secrete 4-ethyl-caprylic acid, 4-ethyl-capric acid etc. when it sexually matures. When these fatty acids contaminate goat milk, the smell increases. We guess the smell in mutton is due to these substances mentioned above. To remove this smell we have to destroy or change these compositions. Now some physical or chemical methods have been used to get rid of the mutton smell in this country. in order not to devaluate mutton nutrition and taste, we were thinking using microbe ferment process which is beneficial to human. The enzymes released in the process could decompose the smelling substances or change their existing form to get rid of the smell. We use a new technological process and scientific prescrption to prepare fermented sausages by artificially inoculating lactobacillus and have produced mutton sausages which basically have no odd smell.

III. Materials and methods

Choosing and preparing fermenting agents

Lactobacillus Plantarum and Streptacoccus Cremoris are mixed to be used as fermenting agents, That is the parent spawn. After activation, it is transferred and cultured to make parent fermenting agents.Mix these tow bacteria in the proportion of 1:1 (W/W) to make working fermenting agets when measured the density is 0.85--1.05 (equivalent to bac-teria number $10^9$ --$10^{10}$ /L) by using spectrometer--721.

Chosing and preparing raw materials

Goat mutton: using mative fresh or frozen goat mutton which has 80% of lean and 20% of fat tissue, cut them into 1 $cm^3$ cubes.

Supplement material: whey,sugar, salt, Chinese prickly ash and ginger powders

Experimental method and technological process

The experimental materials include raw materials as well as fermenting agents with their biological activity and other supplement materials.In order not to let the supplement materials affect the bacteria growth,reproduction and their normal metabolic activities as well as to give the products good flavor,we use orthogonal method to optimize.The results are in table I and II.Group I has been artificially inoculated with Lactobacillus and Group II has not to make the comparison.

Table I. Element and level of option

| Level / Factor | 1 | 2 | 3 |
|---|---|---|---|
| Salt (%) | 1 | 2 | 2.5 |
| Sugar (%) | 3.5 | 4 | 5 |
| Whey (%) | 1.5 | 2 | 2.5 |
| Fermenting agent (%) | 3 | 4 | 5. |

From the table above,we can see that the most important factor which affects the product qualety is the fermenting agents with the range of 6.57; the second impor-tant factor is salt with the range of 4.94,then wney,2.27; the least important factor is sugar with the range of 0.50.

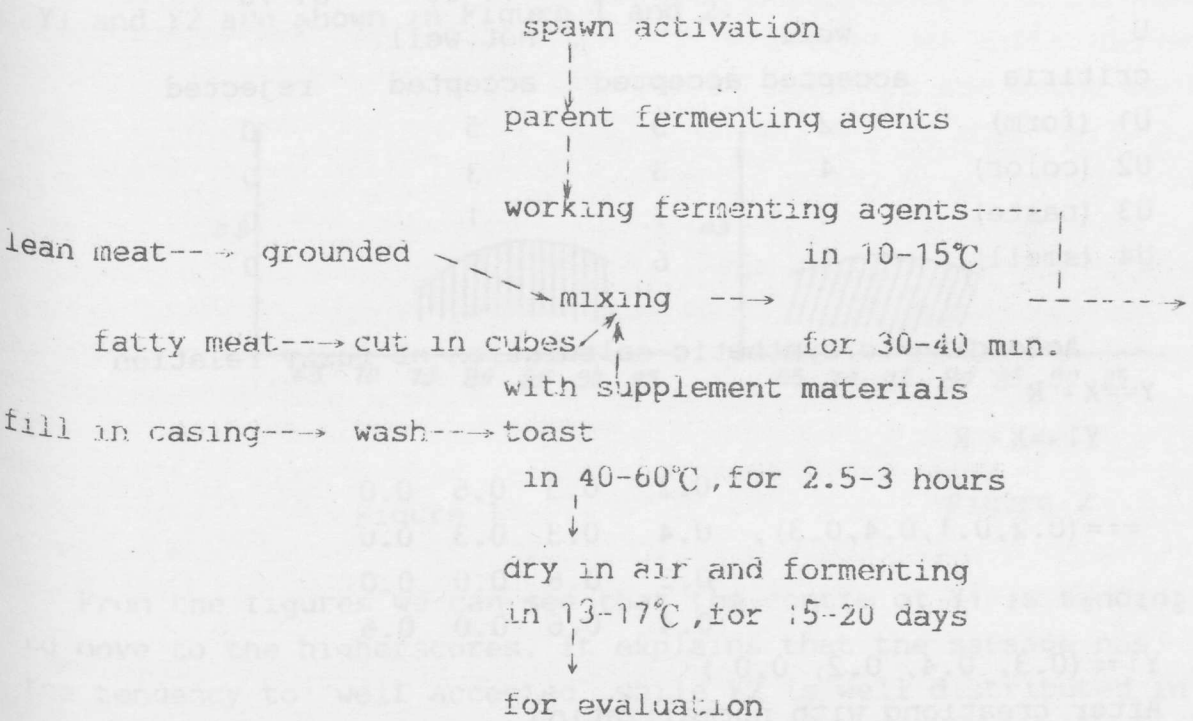
From the results No9 prescription gets the highest mark.We use No9 presciption,that is mutton 500 grams,salt 12.5grams,

Table 11. L9($3^4$) results of the best prescription in orthogonal optimization

| experimental number | factor | | | | items and results | | | | total scores |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | color | taster | tissue's form | odor | |
| 1 | 1 | 1 | 1 | 1 | 3.91 | 4.25 | 3.72 | 4.14 | 16.02 |
| 2 | 1 | 2 | 2 | 2 | 3.69 | 3.52 | 3.40 | 3.85 | 14.47 |
| 3 | 1 | 3 | 3 | 3 | 3.40 | 3.44 | 2.98 | 3.24 | 13.06 |
| 4 | 2 | 1 | 2 | 3 | 3.63 | 3.85 | 3.53 | 3.41 | 14.42 |
| 5 | 2 | 2 | 3 | 1 | 4.66 | 4.11 | 4.03 | 3.76 | 16.56 |
| 6 | 2 | 3 | 1 | 2 | 4.67 | 3.91 | 4.11 | 3.91 | 16.60 |
| 7 | 3 | 1 | 3 | 2 | 4.08 | 3.66 | 4.17 | 3.87 | 15.80 |
| 8 | 3 | 2 | 1 | 3 | 4.04 | 3.63 | 3.95 | 3.99 | 15.61 |
| 9 | 3 | 3 | 2 | 1 | 4.35 | 4.51 | 3.94 | 4.28 | 17.08 |
| total of the level (I) | 43.55 | 46.24 | 48.23 | 49.66 | note: marks are given according to the criterion, the full mark of each item is 5. | | | | |
| total of the level (II) | 47.58 | 46.64 | 45.97 | 46.87 | | | | | |
| total of the level (III) | 48.94 | 46.74 | 45.96 | 43.09 | | | | | |
| range | 4.94 | 0.50 | 2.27 | 6.57 | | | | | |

sugar 25 grams,whey 10 grams,fermenting agent 15 ml.

Technological process




IV. Results and discussion

Choose 10 persons who have no relation with the work and have the appreciation to evaliate as commentaors.

Let them give marks to each item according othecriteria,then use the evaluation method of fuzzy mathematics to make the final evaluation.The results are.

Give U as the universs of discoures of evaluation,

U=={tissue form (U1),color (U2), taste (U3), odor (U4)}

Give V as the universe of discorse of results.

V=={V1 (very accepted),V2 (accepted),V3(mot very accepted),V4 (rejected)}

V1 (91-100),V2 (81-90), V3 (71-80).V4(61-70).

Give weighting assemble as X

X==(0.2,0.1, 0.4, 0.3)

Evaluation results seen in table 3 and 4.

Table 3.Evaluation results of experimental group I

| V | V1 | V2 | V3 | V4 |
|---|---|---|---|---|
| scores | 91-100 | 81-90 | 71-80 | 61-70 |
| U | well | | not well | |
| critiria | accepted | accepted | accepted | rejected |
| U1 (form) | 2 | 3 | 5 | 0 |
| U2 (color) | 4 | 3 | 3 | 0 |
| U3 (taste) | 2 | 7 | 1 | 0 |
| U4 (smell) | 4 | 6 | 0 | 0 |

According to synthetic calculation of fuzzy relation

$Y = X \cdot R$

$Y1 = X \cdot R$

$$= (0.2, 0.1, 0.4, 0.3) \cdot \begin{pmatrix} 0.2 & 0.3 & 0.5 & 0.0 \\ 0.4 & 0.3 & 0.3 & 0.0 \\ 0.2 & 0.6 & 0.0 & 0.0 \\ 0.4 & 0.6 & 0.0 & 0.6 \end{pmatrix}$$

$Y1 = (0.3, 0.4, 0.2, 0.0)$

After treationg with normalization

$Y1 = (0.33, 0.45, 0.22, 0.0)$

Table 4. Evalution result of control group II.

| V | V1 | V2 | V3 | V4 |
|---|---|---|---|---|
| acores | 91-100 | 81-90 | 71-80 | 61-70 |
| U | well | | not well | |
| critiria | accepted | accepted | accepted | rejected |
| U1 (form) | 2 | 3 | 5 | 0 |
| U2 (color) | 4 | 3 | 3 | 0 |
| U3 (taste) | 2 | 7 | 1 | 0 |
| U4 (smell) | 4 | 6 | 0 | 0 |

$Y2 = X \cdot R$

$$= (0.2, 0.1, 0.4, 0.3) \cdot \begin{pmatrix} 0.1 & 0.7 & 0.2 & 0.0 \\ 0.1 & 0.5 & 0.3 & 0.1 \\ 0.1 & 0.3 & 0.6 & 0.0 \\ 0.0 & 0.1 & 0.6 & 0.3 \end{pmatrix}$$

$Y2 = (0.1, 0.3, 0.4, 0.3,)$

After treating in normalization

$Y2 = (0.09, 0.27, 0.37, 0.27)$

According to fuzzy relation , the evaluation results are. The peak value of experimental group Y1 is 0.45, the priduct

gets 81-90 scores, an accepted product. The peak value of control group Y2 is 0.37, 71-80 scores ,a not well accepted product.
Y1 and Y2 are shown in Figure 1 and 2.

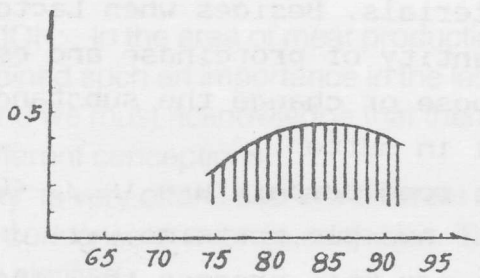



Figure 1

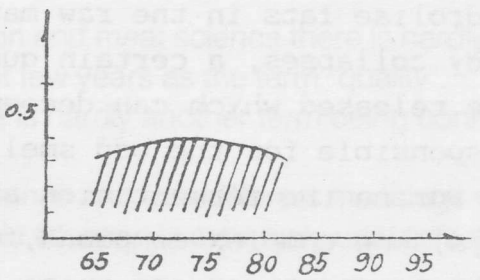



Figure 2

From the figures we can see that the centre of Y1 is tending to move to the higherscores. It explains that the sausage has the tendency to "well accepted" .while Y2 is well distributed in the "not well accepted" range.The evaluation group's opinion to the product is basically of no difference.

Discussion

a. The experiment has been using artificially inoculated Lactobacillus as fermenting agents to produceogroat meat sausage.

Lactobacillus is a kind of facultative anaerobes. with a great,varieties.The nutrition requirement and metabolic aspects differ among the varieties.But they all can decompose lactate to sugars. Lactobacillus plantarum has been used in this experriment ,wjich is adaptable in different environmrents and can exist in different products.The optium growing temperature for Lactobacillus Plantarum is around 30℃ .while it can grow normally in 15℃ .It uses the nutrition in the sausage materials especially the infused matters in the gravy when it is growing to conduct heteromorphosis lactic ferment.The metabolic products are lactate as well as alchohol, acetate and organic materials. These materials will change to esters which make the flavor of the product. There is butterfat streptococcus in the fermenting agents.This bacterion grows fast, produces acids quickly. It belongs to homotypy ferment Lactobacillus. Because they can

produce great quantity of acids in a short time when growing, the pH drops. That has the effect to repress other acid-unendurable organnisms. Resent reseearch has shown that Lactobacillus can produce certain amount of esterase especially these which are released to external space of cells can hydrolise fats in the raw materials. Besides when Lactobacillus body collapses, a certain quantity of proteinase and esterase are released,which can decompose or change the substance responsible for the odd smell in mutton.

During the fermentation at room temperature in 30-40 days,some complex compound,for example,proteins,will decompose into polypeptides and amino adids.This process,too, increases the saugage flavour.

b.The evaluation method we use in this experiment is fuzzy relation . Fuzzy mathematics sees the researched phenomena as universe of discourse in which the related factors are called assemblage.By using calculation to discuss the factors treatment, the results could be shown in figures. The advantage of this is to overcome the differences among commentators in their preferance.The scores discrete.It can solve the problem of 2 or more samples weighted means when they are identical,of thier place arrangement.This method can be used on computer.

V.Conclussion

In this experiment artificially inoculated Lactobacillus fermented saugage is evaluated as an accepted product and has the tendency to be well accepted product,while the un-inoculated control is evaluated as a "not well accepted" product.

VI. Refference

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5. Zhou Liang-yuan et al.(1987) The Cyclic Ether Substance for Getting Rid of the Odd Smell in Goat Milk and Its Mechanism, Food Science,1 issue.