Freshness Detection of Animal-derived Food

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Abstract

The freshness of animal-derived food is an important index to evaluate its quality. Declining freshness of animal-derived food threatens people's health. In order to grasp the methods of freshness detection of animal-derived food, the sensory examination of pork, oil and milk, the determination of total volatile basic nitrogen of pork, the determination of the acid value and peroxide value of the oil, and the determination of the acidity of the milk were carried out. At the same time, the differences between sensory examinations and physical and chemical tests were explored.

Keywords

Animal-derived food, freshness detection.

1. Introduction

Food safety incidents happen frequently, and food safety has become a very prominent social problem, which directly affects the health of the people [1]. Animal-derived food is an important part of human food. Because it is rich in various nutrients, it is favored by consumers. However, animal-derived food is easily corrupted and deteriorated during storage and transportation, resulting in a decrease in freshness, which directly affects people's health to a large extent [2]. The freshness of animal-derived food refers to the standard flavor, smell, taste, color,texture and physical and chemical index, which is an important index to evaluate its quality [3].In order to grasp the methods of the freshness detection of animal-derived food, the sensory examination of pork, oil and milk, the determination of total volatile basic nitrogen (TVBN) in pork, the determination of the acid value and peroxide value of the oil, and the determination of the acidity of the milk were carried out. At the same time, the differences between sensory examinations and physical and chemical tests were explored.

2. Materials

2.1 Main Reagents

2.1.1 Determination of TVBN Value of Pork

Magnesium oxide suspension (10 g/L), methylene blue-methyl red indicator (2 g/L methyl red-ethanol indicator mixed with 1 g/L methylene blue indicator), 0.01 mol/L hydrochloric acid solution, boric acid absorption solution (20 g/L).

2.1.2 Determination of Acid Value of Oil

Neutral ethyl ether-ethanol (2:1) mixture, 1% phenolphthalein indicator, 0.1 mol/L standard KOH solution.

2.1.3 Determination of Peroxide Value of Oil

Trichloromethane-glacial acetic acid mixed solution (4:6), potassium iodide saturated solution, 0.5% starch solution, sodium thiosulfate standard solution (0.1 mol/L).

2.1.4 Determination of Acidity of Milk

0.1% phenolphthalein indicator, 0.1 mol/L NaOH solution.

2.2 The Main Instrument

The automatic Kjeldahl nitrogen analyzer OLB9870 was purchased from Shandong Boko Scientific Instrument Co., Ltd.

2.3 Sample Collection and Processing

All the sample was from the market in Rongchang, Chongqing, China. The samples were sealed with fresh-keeping film. They were placed at 4 ℃ and stored for one week. The oil A was placed for one year.

3. Methods

3.1 Detection of the Freshness of Pork

3.1.1 Sensory Examination of Pork

Appropriate samples were taken in the white porcelain dish, and the color, tissue status, viscosity and smell of pork were examined at 20 °C in natural light.

3.1.2 Determination of TVBN Value of Pork

Took 10 g sample to be chopped and mixed well, added 100 mL distilled water, dipped 30 minutes, and then filtered it into the 250 mL conical flask to reserve. Put 5 mL filtrate and 5 mL oxidase suspension into the digestible tube of the automatic Kjeldahl nitrogen analyzer, and then took another 250 mL clean conical flask and dropped 5 drops of methylene blue-methyl red indicator inward, put it at the lower end of the condensing tube. When the first drop of condensed water appeared, timing began, and the distillation was stopped after 5 minutes. Finally, the endpoint was titrated to blue-violet with 0.01 mol/L hydrochloric acid. At the same time set a blank control test, that was, the filtrate was replaced with equal amount of distilled water, the remaining steps were the same as above.

3.2 Detection of the Freshness of Oil

3.2.1 Sensory Examination of Oil

Picked up a small piece of oil with a clean glass rod, placed it in a 50 mL beaker, heat on a water bath to 50 °C, stirred quickly, smelled the odor, and picked a small amount to identify its taste. Then poured the melted lard into a clean glass test tube, observed the transparent state and color of the oil, and placed it at room temperature until it solidified naturally. Paid attention to the color and tissue state of the solidified oil, the color, transparency, odor and taste when melting.

3.2.2 Determination of Acid Value of Oil

Two clean conical flasks were used to weigh oil sample A and oil sample B (2.0 g), respectively, and another clean conical flask was used without sample as a blank control. Added 30 mL ethyl ether-ethanol mixture to the three bottles and carefully mixed by shaking. After the oil was dissolved, 2 drops of 1% phenolphthalein indicator was added and titrated with 0.1 mol/L standard KOH solution until the solution appeared light red and did not change color within 30 s. According to the consumption of KOH solution, the acid value of oil was calculated.

3.2.3 Determination of Peroxide Value of Oil

Weighed 2.0 g of oil sample A or sample B into a clean conical flask and added 30 mL Trichloromethane-glacial acetic acid mixed solution to completely dissolve the sample. Sample A and Sample B were handled separately. Added 1 mL of potassium iodide saturated solution, immediately squeezed the stopper, and shook gently for 1 minute, then placed it at 15-25 °C in the dark for 5 minutes, added 75 mL of distilled water and 5 drops of 0.5% starch solution as indicator. It was titrated by sodium thiosulfate standard solution until the solution turned pale yellow. At the same time set up a blank control (without sample oil), according to the consumption of sodium thiosulfate content, indirectly obtained the content of peroxide of the oil.

3.3 Detection of the Freshness of Milk

3.3.1 Sensory Examination of Milk

An appropriate amount of sample was placed in the 50 mL beaker, and the color and tissue states were observed under natural light. Smelled it and rinsed the mouth with warm boiled water before tasting it.

3.3.2 Determination of Acidity of Milk

Took 10 mL milk sample in a clean conical flask first, then added 20 mL distilled water and 3 drops of 0.1% phenolphthalein indicator in it, shook well, finally titrated with 0.1N sodium hydroxide solution until the solution turned pink, and kept it within half a minute without discoloration. The acidity of milk was calculated based on the consumption of sodium hydroxide [4].

4. Calculation Methods and Evaluation Criteria

4.1 Detection of the Freshness of Pork

4.1.1 Sensory Examination of Pork

The evaluation criteria for sensory examination of pork are shown in Table 1.

Table 1. Evaluation Criteria for Sensory Examination of Pork

Project	Classification		
	Fresh meat	Sub-fresh meat	Metamorphic meat
Color	The muscles are lustrous and red,the fat is white	The muscles are slightly dark, and the fat is lacking in luster	The muscles are not lustrous and the fat is greyish green
Viscosity	Slightly dry or slightly wet, nonstick	Slightly wet, slightly sticky	Wet and sticky
Elasticity	The depression recovers immediately after finger pressing	The depression recovers slowly and cannot fully recover after finger pressing	The depression cannot recover at all after finger pressing, and there are obvious traces
Odor	With normal smell of fresh meat, no peculiar smell	Slightly sour or with slightly ammonia flavor	Smelly

4.1.2 Determination of TVBN Value of Pork

Calculation method:

$$Z = \frac{(V1-V2)*c*14}{M*(5/100)} \quad (1)$$

Notes: Z-the content of volatile base nitrogen in the sample, mg/100g; V_1-the volume of hydrochloric acid or sulfuric acid standard solution used for the determination sample solution, mL; V_2-the volume of hydrochloric acid or sulfuric acid standard solution consumed in the blank group, mL; c-the concentration of hydrochloric acid or sulfuric acid standard solution, mol/L;14-the mass of nitrogen expressed in milligrams equivalent to 1.0 mL of hydrochloric acid standard solution [C(HCI)=0.1000 mol/L]; m-the mass of the sample, g.

The evaluation criteria for TVBN value of pork are shown in Table 2.

Table 2. Evaluation Criteria for TVBN Value of Pork

Project		Fresh pork
TVBN,mg/100 g	≤	15

4.2 Detection of the Freshness of Oil

4.2.1 Sensory Examination of Oil

The evaluation criteria for sensory examination of oil are shown in Table 3.

Table 3. Evaluation Criteria for Sensory Examination of Oil

Project		Lever indicator	
		Level-one	Level-two
Trait and color	Solid state	White, lustrous, fine and smooth, like ointment	White or yellowish, slightly lustrous, fine and smooth, like ointment.
	Melting state	Yellowish, clear and transparent, no sediment is allowed	Yellowish,clear and transparent
Odor and taste	Solid state	With inherent odor and taste and not mixed with other odors and tastes	

4.2.2 Determination of Acid Value of Oil

Calculation method:

$$\text{acid value(mg KOH/g oil)} = \frac{(V*N*56.1)}{W} \quad (2)$$

Notes: V-the volume of potassium hydroxide solution consumed by titration, mL; N-equivalent concentration of potassium hydroxide solution; 56.1-milligram equivalent of potassium hydroxide; W-the mass of the sample, g.

The evaluation criteria for acid value of oil are shown in Table 4.

Table 4. Evaluation Criteria for Peroxide Value of Oil

Project	Lever indicator	
	Level-one	Level-two
Acid value (KOH) / (mg/g)	≤1.0	≤1.3
Peroxide value / (%)	≤0.10	

4.2.3 Determination of Peroxide Value of Oil

Calculation method:

$$X(\%) = \frac{(V1-V0)*c*0.1269}{m} \quad (3)$$

Notes: X-peroxide value of the sample (calculated as sodium thiosulfate), %; V_1-the volume of sodium thiosulfate standard solution used for determination, mL; V_0-volume of sodium thiosulfate standard solution used in the blank group, mL; c-the calibration concentration of sodium thiosulfate mol/L; m-the mass of the sample, g; 0.1269-the mass of 1.00 mmol iodine, g.

4.3 Detection of the Freshness of Milk

4.3.1 Sensory Examination of Milk

The evaluation criteria for sensory examination of milk are shown in Table 5.

Table 5. Evaluation Criteria for Sensory Examination of Milk

Project	Requirement
Color	Milky or slightly yellow
Taste and odor	With the inherent smell of milk, no abnormal odor
Tissue state	Uniform liquid, no clot, no sediment, no foreign objects which can be seen through normal vision

4.3.2 Determination of Acidity of Milk

Calculation method:

acidity (ºT) = the volume of sodium hydroxide standard solution consumed (mL) *10 (4)

The evaluation criteria for acidity of milk are shown in Table 6.

Table 6. Evaluation Criteria for Acidity of Milk

Project	Index
Acidity of cow's milk(°T)	16-18

5. Results

5.1 Detection of the Freshness of Pork

5.1.1 Sensory Examination of Pork

The sample was slightly lustrous, with pink muscles, light yellow fat, slightly sticky and no special odor. It recovered slowly after finger pressing and could not completely recover.

5.1.2 Determination of TVBN Value of Pork

V_1=1.1 mL, V_2=0.7 mL, c=0.01 N, m=9.96 g, Z=11.24 (mg/100 g).

5.2 Detection of the Freshness of Oil

5.2.1 Sensory Examination of Oil

oil A: pale yellow, granular, with obvious abnormal odor.

oil B: solid state: light yellow, glossy, delicate, with a unique aromatic smell of oil and no other odor; melting state: clear and transparent, no sediment.

5.2.2 Determination of Acid Value of Oil

oil A: V = 4.2 mL, W = 1.30 g, N = 0.1 N, acid value = 18.12 (mg KOH/g oil)

oil B: V = 0.6 mL, W = 2.00 g, N = 0.1 N, acid value = 1.68 (mg KOH/g oil)

5.2.3 Determination of Peroxide Value of Oil

oil A: V_1 = 15.00 mL, V_0 = 0.00 mL, m = 1.66 g, c = 0.02 N, X = 2.29%

oil B: V_1=1.40 mL, V_0=0.00 mL, m=1.99 g, c=0.02 N, X=1.8%

5.3 Detection of the Freshness of Milk

5.3.1 Sensory Examination of Oil

The milk was yellowish, with a few local clots, no obvious special odor and no obvious foreign body.

5.3.2 Determination of Acidity of Milk

The volume of sodium hydroxide consumed is 9.42 mL, acidity (°T) = The volume of sodium hydroxide standard solution consumed (mL) * 10 = 94.2 °T.

6. Conclusion

As shown in the sensory examination of pork, the pork sample was sub-fresh meat, and the TVBN value showed that the sample complied with the national fresh pork standard. In fact, the pork has been stored in the freezer for a week. It can be seen that there is a certain difference between the sensory examination and the determination of TVBN, which is consistent with the research results of Wang et al [5]. The author believes that if the TVBN standard of the pork can be appropriately reduced, it may be more in line with the actual situation.

In the detection of the freshness of oil, sensory examination showed that sample A did not meet the criteria of fresh edible oil, while sample B was level-one oil, but the acid value and the peroxide value of the oil showed that both sample A and sample B did not meet the requirements of fresh oil, which indicated that there was a certain deviation between the sensory examinations and the physicochemical tests of the acid value and the peroxide value. In fact, the sample A was actually stored for one year, and the sample B was also stored for one week. Their freshness must have certainly declined, which was not shown in the sensory examination. From this point of view, the detection of the freshness of oil depends on physical and chemical testing methods, which may be more consistent with the actual situation. In addition, Hao et al suggest using thymol blue indicator instead of phenolphthalein to make the change of the endpoint more sensitive [6]. Zhang et al express

that the fat extracted from the oil is often not a pure product, and there are more interfering substances, which affect the color development and thus lower the peroxide value [7].

In the detection of the freshness of milk, the milk is basically consistent with the standard of fresh milk from the sensory examination, but the acidity is far from the standard. In fact, the milk has been stored for a week, indicating that the acidity of the milk is more in line with the actual situation.

In summary, the freshness detection of animal-derived food is not ideal, so the problem of the freshness of animal- derived food cannot be ignored, but a single detection means is not too scientific, sensory examination combines with physical and chemical testing can in a certain extent avoid the harm of illegal merchants. At the same time, the author also hopes that this phenomenon that the freshness fails to reach the standard is limited to the laboratories, and food safety issues will be well solved in the near future.

References

[1] M Zhang, H R Tong, L P Zhang. Safety Status and Countermeasures about Animal-Derived Food. Science and Technology of Food Industry, Vol.26 (2005) No.5, p. 182-186.

[2] X W Qin. Changes in the Quality of Animal-Derived Food during Preservation. Meat Industry, (2009) No.2, p. 36-38.

[3] L S Jiang. Methods of Meat Freshness Detection. Meat Research, Vol.25 (2011) No.1, p. 46-49.

[4] R S Zhao, M W Liang, S Y Wu, et al. Probe into the Relation between Freshness and Acidity of Cow Milk. China Dairy Industry, Vol.43 (2015) No.12, p. 14-15.

[5] T Y Wang, Y J Wang, W Qin. Study on the Difference between Pork's Volatile Base Nitrogen Value and Sensory Index. Science and Technology of Food Industry, (2007) No.12, p. 124-126.

[6] L H Hao, Y Xu. Study on the Method for the Determination of Acid Value in Fish Meal. Feed Industry, (1999) No.11, p. 33-34.

[7] L S Zhang, W B Yuan, H Zhang, et al. Study on the Method for Determining the Peroxide Value of Edible Oil. Chinese Journal of Health Laboratory Technology, Vol.17 (2007) No.10, p. 1886-1887.