



Differences in the Physical Properties of Pork Liver Depending on the Preparation Method --The Current State of Pork Liver in Japan and the Development of Educational Materials--

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Abstract

In Japanese school education, incorporating familiar and socially relevant themes can foster students' interest and curiosity. This study focused on pork liver, a food that is often avoided in Japan due to its distinctive odor and texture despite its high iron content. We explored its potential as a teaching material linking science and health education. Given the current situation in which serious iron deficiency is recognized among women in their 20s to 40s[1], we aimed to utilize pork liver in education as a food ingredient that connects daily life with solving social issues. Following Komaba et al. (1999)[2], this study investigated the effects of different pre-processing methods—soaking in water, soaking in milk, soaking in running water, and boiling and draining—on the moisture content and texture of pork liver. Results showed that only the "boiling and draining" method, which involves heating, resulted in a decrease in moisture content and an increase in firmness, revealing that temperature significantly affects the moisture content and physical property changes. From an educational perspective, these results provide cross-disciplinary learning opportunities across science, home economics, mathematics, and other subjects. By having students measure moisture content and physical properties, analyze the numerical data, and repeatedly consider how it relates to preferences, we believe it will be possible to build a teaching material model that connects students to society through food and develops the skills they need to survive in modern society. Ultimately, this research demonstrates that "scientifically exploring familiar ingredients" can be an excellent educational approach. By scientifically examining the relationship between food preparation and physicochemical properties, students can learn how science can contribute to solving social issues and acquire problem-solving skills rooted in real life.

Keywords: *Cross-curricular learning, food, exploration*

1. Introduction

In school education, incorporating familiar content related to social issues and everyday life is expected to increase students' interest. In recent years, iron deficiency has been identified as a serious health issue in Japan, particularly among women in their 20s to 40s[1]. Pork liver, which is rich in iron, is one food that can alleviate this issue. Therefore, this study focuses on pork liver as a food ingredient that can contribute to alleviating the social issue of iron deficiency in Japan, and aims to develop teaching materials on the theme of "food and health" that can be used in educational settings. In particular, based on current research, this study aims to improve the practicality of pork liver as a teaching material by focusing on changes in the moisture content and physical properties of pork liver during the preparation process of cooking and examining the possibility of improving its ease of handling and taste from a scientific perspective.

2. Methods

2.1 Survey on the Current Situation Regarding Pork Liver Using the Self-Administered Web Survey Tool Qikumo.

The survey was conducted from Friday, July 10, 2025 to Monday, July 14, 2025 using the self-administered online survey tool Qikumo. It targeted 400 men and women aged 15 to 78. The question



asked, "Do you like eating pork liver?" Those who answered "I don't like it" were asked to write down the reason for their answer. Respondents were asked how often they eat it, choosing from "1-3 times a month," "4-6 times a month," "7-9 times a month," "10 or more times a month," or "I don't eat it."

2.2 Experimental Samples

Commercially available pork liver samples were cut into 2.00 x 2.00 (cm) pieces, preparation process, and cooked. Based on the previous study by Komaba et al. (1999) [2], the samples were preparation processed under the following five conditions, including unprocessed. For the water-soaked samples, the liver was soaked in water five times its weight for 30 minutes. For the milk-soaked samples, the liver was soaked in milk five times its weight for 30 minutes. Commercially available milk with a non-fat milk solids content of 8.3% or more, milk fat content of 3.5% or more, and pasteurized at 130°C was used. For the running water-soaked samples, the liver was soaked in running water at a flow rate of 100 ml/min for 30 minutes. For the boiled samples, the liver was heated for 2 minutes in water 10 times its weight (at 100°C when added). The blank was left unprocessed. A non-stick frying pan and a tabletop induction cooker were used for heating. Both sides were heated at 180°C for 30 seconds and 160°C for 1 minute.

2.3 moisture measurement

The moisture content was measured using an infrared moisture meter (FD-720, Kett Electric Laboratory Co., Ltd.) The pre-treated and heated sample was finely chopped, weighed out to 5.00±0.50 g, and spread evenly on a sample dish before starting the measurement.

2.4 Break Measurement

A creep meter (RE2-33005C XZ YAMADEN Corporation) was used for the breakage measurement. The breaking load was measured under the following measurement conditions: plunger P-21 (cutter peaking), load cell 200N, measurement speed 0.50mm/sec, inserted perpendicular to the fiber.

2.5 Statistical Analysis

The moisture content and breakage measurements were analyzed using SPSS 2.9.

3. Results

3.1 Survey On The Current Situation Regarding Pork Liver Using The Self –Administered Web Survey Tool Qikumo.

The preference results obtained from the questionnaire are shown in **Table 1** below.

Table 1: Do you like eating pork liver?

	like	dislike	Neither	total
frequency	133	58	209	400
rate(%)	33.3	14.5	52.3	100.0

Based on the results of Table 1, the frequency of eating each food preference is summarized in **Table 2**.

Table 2. Frequency of eating pork liver for each preference

		Frequency			total
		like	dislike	neither like nor dislike	
	1~3times	101	0	96	197
	4~6times	8	1	5	14



Frequency of eating per month	7~9times	6	0	3	9
	10 or more times	6	0	0	6
	Never eat	12	57	105	174
Total		133	58	209	400

As shown in Table 1, the most common response to pork liver preference was "neither preferred nor disliked." This differs significantly from the results of Seto et al. (2003) [3]. Tables 1 and 2 reveal that most of the people who responded "like" pork liver have the opportunity to eat it at least once a month, while those who responded "dislike" it never eat it. This suggests that those who dislike pork liver consciously avoid it. Among those who responded "neither preferred nor disliked," the reason for the difference between those who eat it and those who don't is likely due to a high level of health consciousness, such as eating it because it's healthy or for iron intake. Possible reasons for not eating it include a lack of experience with it or not knowing how to prepare it. Many of the reasons cited for disliking pork liver were related to its "smell" and "texture," suggesting that these impressions may contribute to a conscious avoidance of pork liver. Surveys like this one are necessary for understanding the actual nature of issues. They provide an opportunity for cross-disciplinary thinking about how to address the issue and develop solutions. Furthermore, they require significant time to analyze large amounts of data and consider how to interpret it. Therefore, in order to solve problems, research aimed at understanding the current situation is thought to contribute to developing students' thinking skills and ability to analyze data.

3.2 Moisture Measurement

The results of measuring the moisture content are shown in **Table 3**.

Table 3. Moisture content values for each preparation process.

Preparation process	Moisture contents (%)
Untreated	63.67±1.97 ^a
Soak in water	66.70±2.44 ^a
Soak in milk	66.16±2.95 ^a
Soak in running water	67.03±2.18 ^a
Boil and drain	53.18±1.67 ^b

(n=4, different letters indicate significant differences p<0.01)

A one-way analysis of variance using SPSS 2.9 revealed significant differences between the groups (p<0.01). Furthermore, Tukey's HSD test was used to confirm specific differences between the groups. Only the boiled liver was significantly different from the untreated liver and other pre-treatments. This is likely due to the heat treatment involved, which likely resulted in the moisture contained within the liver being released into the water along with the scum. The water-soaked, milk-soaked, and running water-soaked livers all involve water treatments at room temperature. The livers absorbed a small amount of water, resulting in a moisture content approximately 3% higher than the untreated livers. However, the changes in moisture content due to these pre-treatments were not statistically significant, indicating that they do not significantly affect the moisture retention of the livers. Currently, there is no literature that clearly defines the moisture content threshold for dryness after cooking. Therefore, it is difficult to determine which pre-treatment is preferable for the cooking conditions used in this study. However, moisture content is a physical indicator common to all foods, and its quantifiable nature has educational value. By providing an opportunity for students to explore across multiple subjects, such as science, mathematics, and home economics, why the moisture content differs depending on the pre-processing method, it is possible to use this as a teaching material to develop scientific thinking skills and the ability to apply them to real life.

3.3 Break Measurement

Table 4 shows the results of measuring the breaking load of pork liver under each preparation condition.

Preparation process	Breaking load (N)
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Untreated	7.75±1.91 ^{ab}
Soak in water	8.10±2.30 ^{ab}
Soak in milk	6.95±2.09 ^b
Soak in running water	9.40±4.66 ^{ab}
Boil and drain	10.08±1.70 ^a

(n=20 for each preparation process. Significant differences between different letters)

A one-way analysis of variance using SPSS 2.9 revealed significant differences between groups ($p < 0.05$). Furthermore, a Tukey's HSD test was used to examine significant differences between groups, revealing only a significant difference between the "milk soaked" and "boiled and drained" groups. Since only one significant difference was observed, the effect of pre-processing on the physical properties (breaking load) of pork liver is considered limited. It is presumed that the "boiled and drained" process required a greater force to break the liver because heat was applied during both pre-processing and cooking. On the other hand, no significant differences were observed in the physical properties of the livers when the type of liquid or method of soaking (water soaking, milk soaking, or running water soaking) was used. This suggests that soaking at room temperature does not significantly alter the tissue structure of pork liver. Therefore, the main factor affecting the physical properties of pork liver is likely the pre-processing temperature, particularly whether or not it is heated.

4. Conclusion

This study investigated the current state of pork liver preparation and its effects on moisture content and physical properties. Under the cooking conditions used, the results suggested that preparation involving heating significantly affected physical properties. One of the reasons of pork liver is currently avoided in Japan is its "difficulty in cooking." Based on the survey results, reasons cited for dislike included taste, texture, and odor, and preparation is being carried out to address these issues. However, a tendency to avoid pork liver remains. Furthermore, among those who answered "neither," there were diverse opinions, such as "I've never eaten it" and "I eat it because it's nutritious." Similar results were obtained in a previous study by Seto et al. (2001) [3]. These results suggest that there is a certain number of passive choices, such as "I don't like it, but I'll eat it." Preferences for moisture content and physical properties depend on individual eating experience, but for those who prioritize texture, increasing the preparation temperature from room temperature to a higher temperature may improve palatability. This may reduce the reasons for avoiding pork liver. From an educational perspective, the results of this study may serve as a model for cross-curricular thinking. The survey's connection to mathematics is strongest. Students are required to think and judge how to statistically analyze the data obtained from the survey. By quantifying the texture, which is one of the reasons why people dislike it, we can consider the conditions that will make it more palatable to more people. We believe there is value in being creative and thinking about other methods, including different cooking methods, in addition to the preparation method used here.

This study focused on pork liver, but there are many other foods in Japan that are similarly shunned. Using these foods as a subject, developing teaching materials that encourage cross-curricular learning through foods rooted in national and regional cultures would be educationally and socially significant. Considering what social problems food can solve, identifying the problems, setting the challenges, and exploring solutions that transcend subjects and fields will contribute to developing problem-solving skills in modern society. By repeatedly collecting, organizing, and analyzing information, it is anticipated that it will be possible to create a teaching material model that allows students to connect with society through food and develop the ability to live in modern society, and this could be considered valuable as a teaching material.

5. Future Perspectives

In addition to moisture content and texture, this research also plans to analyze odor, which affects palatability. Furthermore, since there are a certain number of people who eat pork liver for health reasons, it is also necessary to analyze its nutritional value, such as vitamin A and iron content. By combining moisture content and texture with these, it is possible to create an opportunity to think about "food" from the perspective of multiple technologies, such as science and engineering. By linking "familiar ingredients" with science and engineering technologies, as in the case of pork liver in this research, and exploring them toward problem-solving, it is thought that this could become an educational tool that contributes to the development of problem-solving skills.



6. REFERENCES

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