



vol. 16 / 2023



## **The 7th International Conference on Science Technology**

organized by  
Faculty of Social Science and  
Law Universitas Negeri Manado and  
Consortium of International Conference  
on Science and Technology

# **The Innovation Breakthrough in Digital and Disruptive Era**

# Characteristics Physicochemical and Determination Formaldehyde of Yellow Tofu at Kediri Regency

Jariyah<sup>1</sup>, Andre Yusuf Trisna Putra<sup>1\*</sup>, and Rosita Dwi Agustin<sup>1</sup>  
Email : [andreyusuf.tp@upnjatim.ac.id](mailto:andreyusuf.tp@upnjatim.ac.id)

<sup>1</sup>Department of Food Technology, Faculty of Engineering, UPN "Veteran" Jawa Timur  
Jl. Rungkut Madya No.1, Gn. Anyar, Kec. Gn. Anyar, Surabaya, Indonesia

**Abstract.** Yellow tofu is a typical Kediri food that is easily damaged because it contains protein and high water content. Tofu is prone to added harmful preservatives such as formaldehyde. Therefore, the purpose of this study was to determine the physicochemical properties and detection of formaldehyde in yellow tofu sold by producers in Kediri. seven samples were obtained from tofu producers in Kediri. The analyzes carried out were moisture content, ash, protein, hardness, curcumin detection, formalin detection and sensory evaluation. The data of the physico-chemical properties of yellow tofu was analyzed by ANOVA. Result of this study, showed that the chemical and physical composition varied between samples. Moisture of yellow tofu is between 65.13%-73.40%. Ash of yellow tofu is between 0.82-1.19%. Protein of yellow tofu is between 13.66-18.41%. The firmness of yellow tofu is between 12.30N-25.15N. The highest firmness was sample D. In this study, there is a positive correlation between firmness and texture sensory tests. Sensory test showed that bright yellow tofu received a positive score by the panelists. There is a positive correlation between detection of curcumin and color sensory test. The results showed that all samples were negative formalin.

## 1 Introduction

Tofu is a food product made from soybeans. It (in 100 grams) has 7.8 grams of protein, 4.6 grams of fat, 1.6 grams of carbohydrates and 84.8 grams of moisture. Kediri Regency has a special tofu called "tahu takwa". The "tahu takwa" industry in Kediri has existed since the 1900s pioneered by Bah Kacung. Industrial center tofu located on the street Trunojoyo, Yos Sudarso, and Patimura. Until now, the process of making tofu is still traditional. Tahu takwa has a characteristic yellow color and a firm and chewy texture. Yellow color, obtained from natural dye, turmeric [1].

A number of survey, many products (such as fresh fish, wet noodles and tofu) contain formaldehyde as preservative. Results of sample analysis from Ciputat market, samples were detected containing formaldehyde. Formaldehyde concentrations were 104.87 µg/mL, 11.21 µg/mL, 1.96 µg/mL, 190.80 µg/mL, 201.98 µg/mL, 10.47 µg/mL, and 3.31 µg/mL [2][3]. One sample of tofu contained formalin with a level of 82.5 ppm at the traditional market in Kendari city[4], and the determination of formalin in tofu at the Batusangkar market was that all samples contained formalin. Analysis of formalin in tofu in the city of Banjarmasin shows that the levels of formalin in tofu are sold at the Antasari Sentra market for 13,182 mg/L, the Kesatrian Market for 13,813 mg/L, and the Sunday Of 16,742 mg/L[5].

Formaldehyde is chemical can be toxic and hazardous for human. It is a dangerous and toxic substance which is prohibited through Permenkes RI

No.235/Menkes/VI/1984 concerning food additives, UU No. 7/1996 about food and UU No 8/1999 about consumer protection. Formaldehyde (methanal) is a organic compound with the formula  $\text{CH}_2\text{O}$  and structure  $\text{H}-\text{CHO}$ . The pure compound is a pungent, colourless gas that polymerises spontaneously into paraformaldehyde, hence it is stored as an aqueous solution (formalin), which is also used to store animal specimens. Formalin, if ingested, causes burning sensation, skin blisters, and burning of the mucous membranes. Formalin is prohibited from being used as a food preservative. Toxicity data LD50 (oral, rat) is 100mg/kg, LD50 (oral, guinea pigs) is 260mg/kg, LD50 (oral, rabbit) is 270mg/kg [6].

Tofu can only be consumed 1-2 days in temperature room. In cooled temperature, it can be consume until 6 days [7]. Because of high nutritional value and moisture, so it is easily to overgrown microbes. Therefore, it is necessary preservative to extend the shelf life. Therefore, this tofu has the potential to add dangerous preservatives, such as formalin. Manufacturers utilize formaldehyde in food additives with the purpose of prolonging shelf life, as formaldehyde is a versatile antimicrobial substance capable of eliminating bacteria, fungi, and even viruses. Therefore, in this study, we characterize physicochemical and determination formaldehyde from yellow tofu.

## 2 Material and Method

### 2.1 Sampel preparation

Sampel yellow tofu were obtained from 22 seller at Kediri Regency, East Java, during June-September 2022. From 22 tofu sellers, 7 different yellow tofu producers were obtained. Therefore, 7 producers were used as samples in this study. The sampel was transferred in a refrigerator until it was ready to be analysed.

### 2.2 Moisture content analysis

Samples were weighed as much as  $\pm 2$  g in a crucible whose weight was known. The crucible and its contents were dried in an oven at  $105^{\circ}\text{C}$  for 5 hours. The crucible is transferred to the desiccator then cooled and weighed. The crucible and its contents are dried again until a constant weight is obtained. (AOAC, 2010) as cited in [8]

### 2.3 Ash content analysis

Samples were weighed as much as  $\pm 3$  g in a crucible whose weight was known. The crucible and its contents were incinerated at  $500^{\circ}\text{C}$  for 3 hours. The resultan ash is cooled in desiccator then weighed (AOAC, 2010), as cited in [8]

### 2.4 Protein analysis

Total protein content was determined using micro-Kjeldahl technique. Three steps of the Kjeldahl method were carefully carried out in sequence, digestion, distillation, and titration. 0.2 g of sample was put into the Kjeldahl flask and added  $1.9 \pm 0.1$  gram  $\text{K}_2\text{SO}_4$ ,  $40 \pm 10$  mg  $\text{HgO}$ ,  $2.0 \pm 0.1$  ml  $\text{H}_2\text{SO}_4$ . The sample is boiled until it becomes clear, then the process is stopped and cooled. The sample was put into the distillation apparatus and then added 10 ml of  $\text{NaOH-Na}_2\text{S}_2\text{O}_3$ . Erlenmeyer containing 5 ml of  $\text{H}_2\text{BO}_3$  solution and 4 drops of indicator (0.2% methyl red and 0.2% methyl blue in alcohol (2:1)) is placed in the condenser section. The distillation process was stopped until 50 ml of distillate was in Erlenmeyer. Then the distillate was titrated with 0.02 N  $\text{HCl}$  until it turned gray (AOAC (2010), as cited in [8]

### 2.5 Firmness analysis

The process of measuring hardness (firmness) knows using the instrument namely Texture Analyzer TAXT-2. The sample is placed in the place that has been provided, click the quick test button run or by pressing ctrl+Q. When finished, then Click the absolute (+) peak button, which showed violence and clicked the button absolute (-) peaks. The data is then recorded. (AOAC (2010), as cited in [5]

### 2.6 Qualitative curcumin analysis

Detection of curcumin in acidic and basic solutions were carried out using an acidic solution (pH 4 buffer) and an alkaline solution (pH 10 buffer). Each sample was dripped with an acid and alkaline solution, then the color change was observed. A positive result shown in the dripping of base solution is brownish red, whereas in an acid solution the color is light yellow.

### 2.7 Qualitative formaldehyde analysis

Qualitative analysis of yellow tofu samples was tested with Schiff's reagent. Schiff's reagent can be prepared from a mixture of fuchsin dye, sodium sulfite and hydrochloric acid. 0.1 gram of fuchsin was dissolved in 100 ml of distilled water, added 1.8 gram of sodium bisulfide and 10 ml of  $\text{HCl}$ . 10 gr tofu were cut into small pieces and then pounded until smooth. 50 ml of distilled water was added and shaken until homogeneous for about 30 minutes. Then the sample was filtered using filter paper with Whatman 41 filter paper. The filtrate solution was tested with Schiff's reagent. Put 3 ml of the sample filtrate in a test tube, then add 1 ml of Schiff's reagent and add 1 ml of concentrated  $\text{H}_2\text{SO}_4$ . If color change to bright purplish red, it is positive for formaldehyde [9].

### 2.8 Sensory Analysis

Sensory analysis of yellow tofu was used hedonic scale method, such as color, texture, flavor, and taste by 25 semi-trained panelists. Six levels of hedonic scale were used, namely: 1 (strongly dislike), 2 (dislike), 3 (neutral), 4 (like), and 5 (strongly like) [10].

### 2.9 Data analysis

The data of the physico-chemical properties of yellow tofu were analyzed in triplicate by analysis of variance (ANOVA) using SPSS software. Significant levels were defined as probabilities of 5%.

## 3 Results and Discussion

Yellow tofu from 22 seller at Kediri Regency, East Java. From 22 tofu sellers, 7 different yellow tofu producers were obtained. Therefore, 7 producers were used as samples in this study

### 3.1 Chemical analysis

In this study, chemical analysis of yellow tofu carried out such as moisture, ash and protein content (**Tabel 1**).

**Table 1.** Chemical composition of yellow tofu in Kediri

Sample	Moisture (%)	Ash (%)	Protein (%)
A	65.13±0.07 <sup>f</sup>	0.82±0.42 <sup>a</sup>	18.41±0.05 <sup>a</sup>
B	66.70±0.10 <sup>e</sup>	1.32±0.42 <sup>a</sup>	14.23±0.18 <sup>d</sup>
C	70.28±0.10 <sup>b</sup>	1.15±0.22 <sup>a</sup>	13.66±0.28 <sup>c</sup>
D	67.61±0.30 <sup>d</sup>	1.05±0.06 <sup>a</sup>	17.55±0.16 <sup>b</sup>
E	73.40±1.10 <sup>a</sup>	0.93±0.28 <sup>a</sup>	14.99±0.01 <sup>d</sup>
F	66.68±0.70 <sup>e</sup>	1.19±0.25 <sup>a</sup>	16.44±0.11 <sup>b</sup>
G	69.12±0.71 <sup>c</sup>	1.12±0.19 <sup>a</sup>	13.15±0.17 <sup>c</sup>

\*Value followed by different superscript in same column for different samples are significant different (p<0.05)

Moisture content analysis using thermogravimetric method. The average moisture of yellow tofu is between 65.13%-73.40%. The highest moisture content was sample E, while the lowest was A. According to Sikanna (2016) the moisture content in tofu ranged from 70-90%, while in Hermawan the moisture content was between 80.2%-80.6%. This difference in moisture content is caused by differences soybean varieties, and the manufacturing process (coagulation and pH of acetic acid). Moisture content will affect the texture of the tofu. The higher moisture content, the softer the texture will be [8]. However, based on SNI 01-3142-1998, there is no limit to the water content of tofu.

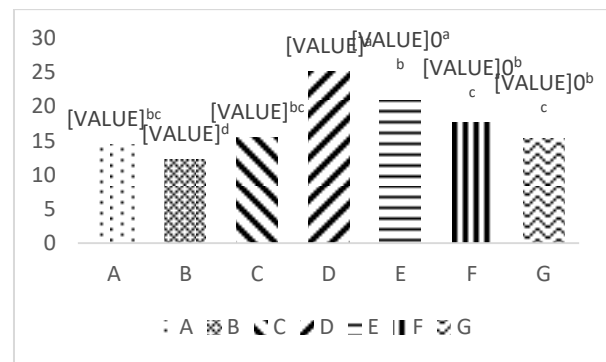
Ash content analysis using thermogravimetric method. The ash of yellow tofu is between 0.82-1.19%. The highest ash content was in sample F, while the lowest was in A. Based on SNI 01-3142-1998, maximum ash content in tofu is 1%. Therefore, samples A and E complied with the regulations, while samples B, C, D, F, G. exceeded the specified limit. Ash content is caused by manufacturing process. If the temperature of grinding is higher, so ash content is higher.

In this study, determination of protein content use Kjeldhal Method. This method is based on measuring the total protein content in the sample. This method is carried out in three stages, namely, digestion, distillation, and titration. Protein of yellow tofu is between 13.66-18.41%. The highest protein content was sample A, while the lowest was sample D. according to [11], protein content is affected by the soybean variety used. In this study, all tofu samples were match with SNI 01-3142-1998, the minimum protein content in tofu is 9%. Therefore, in this research, results all samples comply with these regulations.

**3.2 Firmness**

Firmness is the force required for cut the sample with the blade cut on the tool Texturizers. The texture of tofu is influenced by network structure made up of proteins soya bean. More hardness value Large indicates that the tofu is harder and compact/rigid [12]. In this study, The firmness of yellow tofu is between 12.30N-25.15N. The highest firmness was sample D, while the lowest was sample B. The protein content and the pH of the acetic acid affect the gel strength of

the tofu. The coagulation process of crude protein using acetic acid will make tofu chewy and hard. Therefore, it is suspected that the higher the protein content, the firmer the tofu will be [8].



**Figure 1.** Firmness of yellow tofu in Kediri

\*Value followed by different superscript are significant different (p<0.05)

Firmness of tofu can be suspected of having formalin marks in it food. Tofu food added formalin causes tofu to become harder/stiff. The reaction of formalin with amino acids results in changes protein structure thus affecting the texture of the product becomes more hard/stiff. However, no addition of formalin was found in all tofu samples. Tofu hardness can be influenced by differences in processing, type of soybean, concentration of coagulant agent (acetic acid). This is appropriate [13]. Characteristic of tofu significantly different between soybean varieties. This is appropriate [3], tofu violence significantly different between soybean varieties.

**3.3 Curcumin detection**

In this study, detection of curcumin in yellow tofu were carried out using an acidic solution and an alkaline solution. A positive result shown in the dripping of base solution is brownish red, whereas in an acid solution the color is light yellow. From the results of the curcumin analysis in **Table 2**, it can be seen that five sample were detected, and two sample were not detected.

**Tabel 2.** Result of qualitative test of curcumin and formaldehyde detection in yellow tofu

Sample	Curcumin	Formaldehyde
A	-	-
B	+	-
C	+	-
D	+	-
E	-	-
F	+	-
G	+	-

Turmeric (*Curcuma longa*) rhizome is used as coloring and preservative in tofu. It has curcumin which plays a role in the yellow color of tofu. Turmeric also plays a role as preservative. It can inhibit the growth of total microorganisms, E. coli and S. aureus on tofu storage for 72 hours [14]

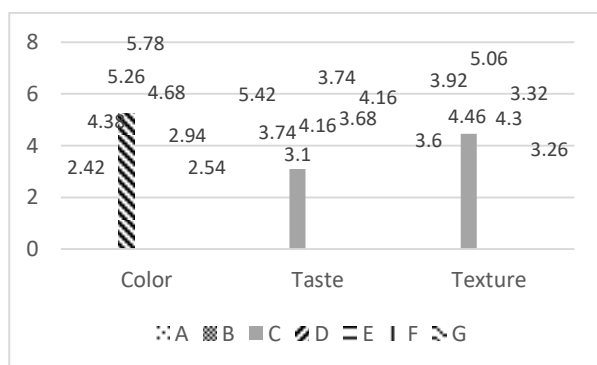
Turmeric, one of an important spice in Indonesia, which is used in tofu processing. Turmeric has also attracted considerable attention over the years due to its use in the food industry as a coloring agent especially in tofu. It has three major coloring pigments compound, such as curcumin (50-60%), demethoxy curcumin (20-30%) and bis demethoxy curcumin (7-20%). This pigments compound are used not only as food coloring, but also as a substance that promotes health and well being by preventing or even healing diseases [15].

### 3.4 Formaldehyde detection

In this study, formalin testing was carried out qualitatively, and with repetition. The results showed that all samples were formalin negative, marked by a color that did not change to bright purple. This is in accordance with the Food Law, Health Law, and implementing regulation Number 1168/Menkes/PER/X/1999, that formalin is not permitted in food products. Formalin is used as a disinfectant, specimen preservative, and wood adhesive. Formalin is often misused as a food preservative in fresh fish, salted fish, chicken and wet noodles (BPOM < 2008). According to Jenica [7], the seller added formaldehyde to make tofu harder/stiffer and more durable. Tofu that is not added formalin usually only lasts 1-2 days.

### 3.5 Evaluasi sensoris

The sensory test aims to determine the panelist's preference for the sensory attributes of a product. In this study, the four sensory attributes of color, taste and aroma were scaled numeric, 1-6.



**Figure 2.** Preference score of panelists on tempeh made of a mixture of tribal bean and soybean. Six level were 1 (strongly dislike), 2 (dislike), 3 (neutral), 4 (like), and 5 (strongly like)

**Color**, the highest value is sample D (5.78), while the lowest value is sample B (2.42). The bright yellow tofu received a positive score by the panelists, while the dark colored tofu received a negative score from the panelists. In this study, there were 5 of 7 samples using turmeric dye.

**Taste**, the highest value is sample A (5.42), while the lowest value is sample C (3.1). Raw materials and

processing processes can contribute to the taste of tofu. Each soybean variety has different chemical characteristics such as protein, fat and water content. In addition, the enzyme lipoxygenase has an effect on taste and aroma, such as beany, green, grassy, painty, astringent, and bitter Soybeans which are modified with deficient lipoxygenase produce soy foods with less undesirable aromas and are therefore likely more acceptable to the consumers [3].

**Texture**, the highest value is sample D (5.06), while the lowest value is sample A (3.6). In this study, panelists prefer firm tofu rather than soft. this is in accordance with the hardness analysis, sample D has the highest hardness compared to other samples.

## 4 Conclusion

Result of this study, the chemical and physical composition are varied between samples. Moisture of yellow tofu is between 65.13%-73.40%. Ash of yellow tofu is between 0.82-1.19%. Protein of yellow tofu is between 13.66-18.41%. The firmness of yellow tofu is between 12.30N-25.15N. The highest firmness was sample D. In this study, there is a positive correlation between firmness and texture sensory tests. Sensory test showed that bright yellow tofu received a positive score by the panelists. There is a positive correlation between detection of curcumin and color sensory test. The results showed that all samples were negative formalin

## 5 References

- [1] R. D. Prihandini and Artono, "Eksistensi Industri Tahu Kuning Di Kediri Tahun 1990-2020," *J. Pendidik. Sej.*, vol. 10, no. 3, pp. 1-9, 2021, [Online]. Available: <https://ejournal.unesa.ac.id/index.php/avatara/article/view/40960/35363>.
- [2] Z. Zilhada and S. Susanti, "Determination Of Formaldehyde In Tofu From Ciputat Traditional Market With Colorimetry Method," *J. Kim. Val.*, vol. 2, no. 2, 2011, doi: 10.15408/jkv.v2i2.204.
- [3] A. Yang, H. Smyth, M. Chaliha, and A. James, "Sensory quality of soymilk and tofu from soybeans lacking lipoxygenases," *Food Sci. Nutr.*, vol. 4, no. 2, pp. 207-215, 2016, doi: 10.1002/fsn3.274.
- [4] I. Ifriani, S. Wahyuni, and H. Amin, "Analisis Kandungan Bahan Pengawet Formalin Pada Tahu Yang Diperdagangkan Dipasar Tradisional Kota Kendari (Pasar Panjang, Pasar Anduonohu, Pasar Basah Dan Pasar Baruga)," *J. Sains dan Teknol. Pangan*, vol. 1, no. 2, pp. 125-130, 2016.
- [5] A. N. Sari, R. Rahmadani, and N. Hidayah, "Identifikasi Kadar Formalin Pada Tahu Mentah Yang Dijual Di Pasar Tradisional Kota Banjarmasin," *J. Pharm. Care Sci.*, vol. 2, no. 1, pp. 5-14, 2021, doi: 10.33859/jpcs.v2i1.124.

- [6] Badan POM RI, “Informasi Penggunaan Bahan Berbahaya (Formalin),” in *Bpom*, 2008, pp. 1–29.
- [7] A. S. Jenica Arnola Manoe, Indriati A. Tedju Hinga, “Uji Organoleptik Produk Tahu Berdasarkan Suhu dan Lama Penyimpanan Terhadap Mutu Tahu di Kabupaten Kupang Tahu merupakan salah satu makanan tradisional yang mempunyai nilai gizi yang sangat tinggi . kebutuhan rumah tangga . Bahan pangan yang secara alamia,” *J. Public Health (Bangkok)*, vol. 1, no. 2685–4457, pp. 96–108, 2019.
- [8] H. Seftiono, “Perubahan Sifat Fisiko Kimia Protein Selama Proses Pembuatan Tahu sebagai Rujukan Bagi Posdaya,” *J. Kesejaht. Sos.*, vol. 3, no. 1, pp. 85–92, 2017.
- [9] A. Atikah, B. Ronggopuro, S. Sumari, and Y. Utomo, “Study of Formaldehyde Content in Different Types of Tofu Using Micro Scale Laboratory Based Visible Beam Spectrophotometry Studi Kandungan Formalin pada Berbagai Jenis Tahu Menggunakan Spektrofotometri Sinar Tampak Berbasis Micro Scale Laboratory,” *J. Ilm. Berk. Sains dan Terap. Kim.*, vol. 17, no. 1, pp. 35–40, 2023.
- [10] T. F. Djaafar, N. Cahyaningrum, and H. Purwaningsih, “Physico-Chemical Characteristic Of Tribal Bean (*Canavalia virosa*) and Its Alternative Tofu and Tempeh Food Product,” *Indones. J. Agric. Sci.*, vol. 11, no. 2, p. 74, 2013, doi: 10.21082/ijas.v11n2.2010.p74-80.
- [11] U. A. Yasin, J. T. Horo, and B. A. Gebre, “Physicochemical and sensory properties of tofu prepared from eight popular soybean [*Glycine max* (L.) Merrill] varieties in Ethiopia,” *Sci. African*, vol. 6, no. October, 2019, doi: 10.1016/j.sciaf.2019.e00179.
- [12] N. Aryanti, D. Kurniawati, A. Maharani, and D. H. Wardhani, “Karakteristik Dan Analisis Sensorik Produk Tahu dengan Koagulan Alami,” *J. Ilm. Teknosains*, vol. 2, no. 2/Nov, 2016, doi: 10.26877/jitek.v2i2/nov.1206.
- [13] D. Supriatna, - Rienoviar, H. G. Pohan, E. Hawani Lubis, and M. Isyanti, “Protein Coagulation Profile of Mix Sword Bean (*Canavalia ensiformis* DC) and Soybean Tofu,” *War. Ind. Has. Pertan.*, vol. 36, no. 2, p. 62, 2019, doi: 10.32765/wartaihp.v36i2.4774.
- [14] N. Tohyeng, R. Dewanti-Hariyadi, and H. Nuryani Lioe, “Application of Turmeric Extracts to Control Microbial Growth in Tofu During Storage,” *J. Teknol. dan Ind. Pangan*, vol. 29, no. 1, pp. 19–28, 2018, doi: 10.6066/jtip.2018.29.1.19.
- [15] A. M. H., “Use of Yellow Pigment Extracted from Turmeric (*Curcuma Longa*) Rhizomes Powder as Natural Food Preservative,” *Am. J. Food Sci. Technol.*, vol. 2, no. 1, pp. 36–47, 2014, [Online]. Available: <http://pubs.sciepub.com/ajfst/2/1/6/index.html>.