FORMALINE DETECTION IN TOFU SOLD IN THE MARKET GORONTALO CITY TRADITIONAL USING PURPLE SWEET POTATO EXTRACT

Waridatul Khosidah[1)], Adnan Malaha[2)], and Erfan AR Lainjong[3)]
[1,2,3)]Bina Mandiri University of Gorontalo
Email :waridatulkhosidah@gmail.com

ABSTRACT

Formalin is a chemical whose use is prohibited for food products.Formalin with its trade name is formaldehyde in water with a content of 30-40%. Formaldehyde contamination in foodstuffs is very harmful to the body. Formaldehyde can cause cancer of the respiratory tract and increase the risk of leukemiaThis study aims to determine the presence or absence of formalin content in tofu using purple sweet potato extract which was carried out using the maceration extraction method.Natural ingredients containing anthocyanins can be used as an alternative to formalin testing.

This study used a qualitative research method using purple sweet potato extract as an inspection indicator because it contains anthocyanin which is capable of detecting the presence of formaldehyde in tofu by means of a color change reaction.anthocyanin which is amphoteric in nature which has the ability to react well with acidic and basic pH, if in an acidic medium the anthocyanin will turn red. Formalin is acidic, so when anthocyanin meets formalin it will produce a red color that is increasingly concentrated. Meanwhile, if the anthocyanin pigment does not change color to red or remains in its original color, then it does not contain formalin. Anthocyanins will change color as the pH value changes

The results showed that the 19 tofu samples tested were declared negative as indicated by the absence of a reddish-blue discoloration reaction.

Keywords: Tofu, Purple Sweet Potato Extract, Anthocyanins.

INTRODUCTION

Food Additives (BTM) are ingredients or a mixture of ingredients which naturally are not part of the food raw materials, but are added to food to affect the nature or form of the food, including coloring agents, preservatives, flavourings, anti-clots, bleaching and thickeners. Food Additives or food additives are also defined as ingredients added and mixed during food processing to improve the quality of food products [12].

Tofu is one of the foods that is popular with people today, especially Indonesian people, because the price is very affordable. Tofu is made from soybeans that have gone through a protein deposition process. Tofu is included in perishable foodstuffs. Damage to white tofu is characterized by a sour and slimy smell. The preservation practice that is often carried out by traders is soaking

Submit: Jan. 19th, 2023 Accepted: Feb. 16th, 2023 Published: March. 18th, 2023

tofu using formalin, so that tofu is not easily destroyed, resistant to microorganisms, and can last up to seven days [23].

This is because Formalin is carcinogenic, which means it can trigger cancer by the United States Environmental Protection Agency (EPA) and the International Institute for Research on Cancer (IARC) [6].

Formalin is often abused as a preservative in tofu, chicken, wet noodles and salted fish. Currently, formalin is often abused as a preservative in food products such as tofu. The Indonesian government has also banned the use of formaldehyde as a food preservative since 1982 [23].

Formaldehyde contamination in foodstuffs is very harmful to the body. Formaldehyde can cause cancer of the respiratory tract and increase the risk of leukemia. The International Agency for Research on Cancer (IARC) classifies formaldehyde into group 1 [14].

Formalin in 98 samples of food products with details of 23 samples of wet noodles 15 samples containing formalin (65%), 34 samples of various salted fish, 22 samples containing formalin (64.7%), and 41 samples of tofu all contaminated (100%) [19].

From the results of the examination [19] the results of a study conducted on 9 samples of tofu sold in 5 markets in Kendari City, namely Kota Market, Baruga Market, Anduonohu Market, Mandonga Wet Market and Lawata Market using the chromatopathic acid reagent method, it was concluded that there was 1 sample of tofu positive for containing formalin, namely the tofu sample obtained from Anduonohu Market, Kendari city which showed a change in color to purple after the addition of chromatopathic acid reagent.

Tests for the formalin content of food are usually carried out through an assessment in a laboratory facility using chemicals, so it is difficult for people to carry out tests independently, they are easy to obtain in everyday life at generally low cost. Natural ingredients containing anthocyanins can be used as an alternative to formalin testing which can be done independently [16].

Based on the description above, the authors are interested in conducting research on "Detection of formaldehyde in tofu at Traditional Markets in Gorontalo City using purple sweet potato extract".

1. Overview of Foodstuffs

Safe food is food that is free from chemical, physical and microbiological contamination. The presence of contamination in food and beverages can occur because of the raw materials used to make food products. The raw material may have been contaminated before being processed. Unsafe food can also occur due to imperfect processing or poor storage and marketing methods and presentation of processed foods [26].

Food safety is an effort to prevent the possibility of biological (microbiological), chemical and other objects that disturb, harm and endanger human health [20].

a. Food Quality Standards

Food is a basic need for every human being to support their survival. Food is a basic human need, the fulfillment of which is the basic right of every Indonesian people in realizing quality resources to carry out national development. Food that is safe, of good quality, nutritious, diverse and sufficiently available is the main requirement that must be fulfilled in the effort to implement a food system that provides protection for health interests and plays an increasingly important role in increasing the

prosperity and welfare of society [20].

2. Tofu

Tofu is a food product made from soybeans (glycine max), which is solid and has a soft texture. Made through the processing of soybeans by precipitating protein. Tofu has a fairly high nutritional value, because soybeans are a source of vegetable protein derived from nuts and seeds with protein quality that is almost close to animal protein. This is because soybeans contain a lot of essential amino acids that are needed by the body for cell growth and development. The protein content in soybeans is around 35% and even reaches 40-43% in superior varieties [19].

Tofu is a product made from the coagulation of precipitated soy protein. So that the protein content in tofu is determined by the protein content in the soybeans used. Yellow soybeans and black soybeans are the types of soybeans that are often used to make tofu. Protein content in soybeans reaches 35% and can even reach 40-43% in soybeans with superior varieties. The protein content in tofu is higher when compared to rice, corn, cassava flour, green beans, meat, fresh fish, and chicken eggs [2].

3. Overview of Food Additives

Food Additives are ingredients that are not normally used as food and are usually not typical food ingredients, whether or not they have nutritional value, which are intentionally added to food. The purpose of using food additives is to increase and maintain the nutritional value and quality of food [6].

Food Additives in everyday life are widely used in the manufacture of various kinds of food. According to [9] the function and purpose of using food additives in food, namely:

a. To preserve food by preventing the growth of food-destroying microbes or preventing chemical reactions that can reduce the quality of food.
b. Making food better, crunchier and more delicious in the mouth.
c. It gives a more attractive color and aroma so that it adds to the taste.
d. Improve food quality.
e. Save cost

4. Formaldehyde

a. Definition of formaldehyde

Formalin is a chemical substance that contains the elements carbon, hydrogen and oxygen, and has another name formaldehyde. Physically present in 9 forms of colorless solution with levels between 37-40%. Formalin usually contains 10-15% alcohol/methanol which functions as a stabilizer to prevent the polymerization of formaldehyde into paraformaldehyde which is highly toxic [19].

Formalin is the trade name for Formaldehyde solution in water with a concentration of 30-40%. Formalin can also be obtained on the market in a diluted form, with formaldehyde levels of 40, 30, 20 and 10%, and in tablet form which weighs about 5 grams each [9].

b. Dangers of formaldehyde to the body

According to [8] the dangers of formalin for the body include:

1) Short term hazard (Acute)

The dangers that will occur if inhaled formaldehyde vapor in the short term, namely: irritation occurs, burning sensation in the throat and nose, coughing, nervous disorders, tissue damage and injuries to the respiratory tract such as pneumonia and lung

swelling, general signs , sneezing, sore throat, excessive chest pain, palpitations, nausea and vomiting, at very high concentrations can cause death.

Pure formalin or formalin solution, in the form of a liquid that splashes very easily, for example when pouring formalin if it gets on the skin, the skin will experience a change in skin color, the skin feels burned, becomes red, hardens and numb. If formaldehyde comes into contact with the eyes, it can cause eye irritation, the eyes become red, itchy, blurred vision and tears. At high concentrations it can damage the eye lens. The situation is very worrying if swallowed formalin solution will cause burning in the mouth, throat and stomach, painful swallowing, nausea, vomiting and diarrhea, possible bleeding, severe stomach pain, headache, hypotension (low blood pressure), convulsions, unconscious into a coma. In addition, damage to the liver, heart, brain, spleen, pancreas,

2) Long-term (chronic) hazard

If there is continuous long-term exposure to formaldehyde, inflammation of the mucous membranes of the nose, coughing and breathing problems, lung sensitivity, cancer of the nose, throat, mouth, lungs and muscles, kidney injuries, menstrual disorders and infertility in women. neuropsychic effects, headaches, sleep disturbances, irritability, disturbed balance, nausea, loss of concentration and reduced memory. This happens when formalin vapor is continuously in a relatively long time.

c. Prevention Against Formaldehyde

According to IPCS (International Program on Chemical Safety), in general, the safe threshold for formalin precautions is carried out based on the route of entry of formalin into the body, namely:

1) inhaled

To prevent being inhaled, use protective equipment for breathing such as a mask, cloth, or protective equipment that can prevent the possibility of formalin entering the nose or mouth. Equip ventilation devices with explosion-proof suction.

2) Hit the eye

Wear protective eyewear or goggles, splash-resistant housing. Meanwhile, water for washing the eyes in a place that is useful in case of an emergency.

3) Skin contact

Wear suitable chemical protective clothing and wear chemical resistant gloves

4) swallowed

Avoiding food, smoking while working and washing hands before eating [9].

5.Purple Sweet Potatoes

a. Definition of Sweet Potato

Purple Sweet Potato (Ipomea Batatas L,) or sweet potato or "sweet potato" is thought to have originated from the Americas. Botanists and agricultural experts estimate the origin of the sweet potato plant is New Zealand, Polynesia, and Central America. Nikolai Ivanovich Vavilov, a Soviet botanist, confirmed that the primary center of sweet potato origin was Central America [15].

b. Classification of Purple Sweet Potatoes

As for plant systematics (taxonomy), sweet potato plants are classified as follows:

1) Kingdom : Plantae (plants)
2) Division: Spermatophyta (seed plants)
3) Sub Division : Angiosperms (closed seeds)
4) Class : Dicotyledonae (seeds in two pieces)
5) Order: Convolvulales
6) Family : Convolvulaceae
7) Genus: Ipomeae
8) Species : Ipomeae batatas L. Sin. Batata edulis Chois

6. Content of Purple Sweet Potato

Purple Sweet Potatoes contain natural dyes anthocyanin, beta-carotene, vitamins and minerals. Anthocyanin content is useful as an antioxidant that can absorb air populations, oxidation in the body, and inhibit blood clotting so as to improve blood flow. And the content of beta-carotene, vitamins E, and C are useful as antioxidants to prevent cancer and various cardiovascular diseases. In addition, fiber and pectin are very good for preventing digestive disorders, such as hemorrhoids, constipation, and colon cancer. The active content of selenium and iodine is 20 times higher than other sweet potatoes so that purple sweet potato can be anticancer [19].

Purple sweet potato was used as formalin identification because purple sweet potato contains anthocyanin compounds as much as 519 mg/1100g wet weight. Found in purple sweet potato, among others, cyanidin, pelargonidin, peonidin and malvidin. The most constituent of anthocyanins in purple sweet potato is monoacyl from caffeic acid, while the others are in the form of diacyl from caffeic acid and p-hydroxybenzoic or caffeic acid and ferulic acid [16].

7. Anthocyanins

Anthocyanin (English: anthocyanin, from a combination of Greek words: antho = "flower", and cyano = "blue") is a water-soluble pigment that is naturally found in various types of plants. As the name implies, this pigment gives color to flowers, tubers, fruit and plant leaves which have been widely used as natural dyes in various food products. Color is given by anthocyanins due to the long arrangement of conjugated double bonds. This conjugated double bond system is also capable of making anthocyanins as antioxidants with free radical scavenging mechanisms [27].

The presence of anthocyanins in nature is the most abundant. Based on some of the results of research conducted, it shows that the sources of anthocyanins are mainly found in natural materials, especially in plants. The presence of anthocyanins in plants is located in the vacuole cells of the plants themselves, so that most anthocyanins are found and can be extracted from several plant organs, such as flower crowns, leaves, fruit, seeds, to tubers. The anthocyanin found in purple sweet potato has a concentration of (5.92-11.02 mg/25 g fresh sweet potato) [17].

a. Anthocyanin Structure

Anthocyanins are natural dyes belonging to the flavonoid group with three carbon atoms bonded by an oxygen atom to connect two benzene aromatic rings (C6H6) in the main structure, derived from the Greek word meaning blue flower. Anthocyanins have the characteristics of a carbon skeleton (C6C3C6) with the basic structure of anthocyanins being 2-phenyl-benzofirilium from flavilium salts.

The structure of the anthocyanin flavilium can be seen in Figure 2.1.

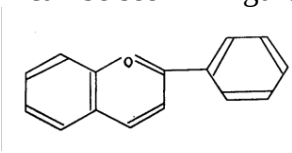

Figure 1: Flavilium Anthocyanin Structure
(Source :Priska et al, 2018).

8. Formalin Qualitative Test

Analysis of formaldehyde content in food can be carried out using qualitative and quantitative methods. The qualitative method aims to determine the presence or absence of formaldehyde in food. Formalin qualitative tests can be carried out using chemical reagents which can cause a distinctive color complex if the sample is positive for formalin. The use of chemical reagents can be dangerous to users if they do not understand the nature of the reagents used [1].

Qualitative detection of formaldehyde in food can also be carried out using natural materials, namely utilizing the anthocyanin content in several types of plants such as purple sweet potato by observing the color change of the anthocyanin extract reacted with a solution of food samples suspected of containing formalin [20].

a. Principle of Anthocyanin Reaction with Formalin

Anthocyanin extract is able to detect the presence of formalin in food with an indicator of the color change seen in the sample after being dripped with anthocyanin solution. The color change to red occurs at an acidic pH of 1-5 while the color change to purple, blue and green occurs in the pH range of 6-12 [16].

Anthocyanin substances will react quickly with formic acid content which is a strong acid resulting from the formaldehyde oxidation process. The study stated that fruits that contain a lot of anthocyanins such as dragon fruit, grapes, strawberries, and purple sweet potatoes can be used as a base for making a test solution for the presence of formalin. According to research, anthocyanin extract from purple sweet potato has been tested to be able to detect the presence of formaldehyde in food with the appearance of a more visible color change when tested on samples than using other sources of anthocyanin such as dragon fruit and grapes. Visible color changes are influenced by anthocyanin levels in these plants [10].

RESEARCH METHODS

This research is included in a qualitative approach that is descriptive in nature. Qualitative research to describe the presence or absence of formaldehyde in tofu sold at Traditional Markets in Gorontalo City.

The type of research used in this study was an observational descriptive study by detecting or testing formalin on tofu at the Gorontalo City Traditional Market using purple sweet potato extract.

The types of data used in this research are primary data and secondary data. The primary data in this study were the results of formalin testing on tofu samples obtained from examinations at the Laboratory of Bina Mandiri University, Gorontalo. Meanwhile, secondary data was obtained from books and previous researchers.

In this study, the validity of the data used was determined by laboratory testing using qualitative methods, by looking at the positive and negative controls compared to the color of the sample used. The color change that occurs in the

formalin content test is that if the tofu given purple sweet potato extract turns to reddish blue, the sample is positive for formaldehyde, but if the tofu given purple sweet potato extract does not change color then the sample does not contain formalin.

RESEARCH RESULT

Table 1. Formalin qualitative test results on tofu

No.	Sample Code	Reaction	Results
1.	Moodu Market 1	No color change occurs	Negative
2.	Moodu Market 2	No color change occurs	Negative
3.	Moodu Market 3	No color change occurs	Negative
4.	Moodu Market 4	No color change occurs	Negative
5.	Moodu Market 5	No color change occurs	Negative
6.	Moodu Market 6	No color change occurs	Negative
7	Central Market 1	No color change occurs	Negative
8	Central Market 2	No color change occurs	Negative
9	Central Market 3	No color change occurs	Negative
10	Andalas Market 1	No color change occurs	Negative
11	Andalas Market 2	No color change occurs	Negative
12	Andalas Market 3	No color change occurs	Negative
13	Andalas Market 4	No color change occurs	Negative
14	Andalas Market 5	No color change occurs	Negative
15	Liluwo Market 1	No color change occurs	Negative
16	Liluwo Market 2	No color change occurs	Negative
17	Dungingi Market	No color change occurs	Negative
18	Dumbo Market	No color change occurs	Negative
19	Rakyat Bugis Market	No color change occurs	Negative

Source: primary data, 2022

DISCUSSION

In this study, samples of tofu were obtained from several markets in Gorontalo City, namely Moodu Traditional Market, Central Market, Andalas Market, Liluwo Market, Dungingi Market, Dumbo Market, and Bugis Folk Market. The tofu sample was taken by accidental sampling, that is, all the tofu found by the researcher was used as a sample. The sample is then packaged and brought to the laboratory for later identification. This study aims to determine whether the tofu sample contains formaldehyde or not.

Before testing the tofu sample with purple sweet potato extract as a reagent, the test was carried out using a positive control and negative control as a comparison. The positive control contained 2 ml of formalin and the negative control contained 2 ml of distilled water, which was then added with a few drops of purple sweet potato extract. A positive result was indicated by a change in the color of the purple sweet potato extract which was originally purple to reddish blue after reacting with the sample.

Based on the results of the formalin detection examination on the 19 years tested in the laboratory using purple sweet potato extract, the results were negative or did not contain formalin. This is evidenced by the purple sweet potato extract on tofu samples sold at the Gorontalo City Traditional Market, where the purple sweet potato extract was

dripped into the mashed tofu and then seen that there was no reaction to a reddish-blue discoloration, meaning that the tofu did not contain formalin.

CONCLUSION

Based on the results of a formalin detection study of 19 samples of tofu sold at Traditional Markets in Gorontalo City using purple sweet potato extract, it can be concluded that all samples were negative or did not contain formalin. This is indicated by the absence of a color change reaction.

REFERENCES

[1] Alfitasari, D., Rizmiati, Z., dan Sulistiastutik. (2020). Pengaruh Variasi Pelarut Ekstraksi dan Daya Simpan Terhadap Kadar Antosanin dalam Tes Kit Uji Formalin Berbahan Dasar Ubi Jalar Ungu (*Ipomea batatas L.Poir*). Jurusan Gizi. Program Studi D3 Anafarma. Politeknik Kesehatan Kemenkes Malang. VOL. 1 NO. 1 Oktober2020

[2] Benyamin, N. C., (2019). Analisis Kandungan Formalin Pada Tahu yang dijual Di Pasar OeboboKota Kupang. Karya Tulis Ilmiah, Program Studi Analis Kesehatan Politeknik Kesehatan Kupang. Kupang.

[3] Dunggio, S. (2014). Identifikasi Kandungan Formalin Pada Tahu yang Dijual Di Pasar Sentral Gorontalo. *Skripsi*, 1(811409077).

[4] Fadilah, R.(2017). Bahan Tambahan Makanan. *Bahan Ajar*. Universitas Negeri Makassar.

[5] Fitriani, D., Trihadi, B., dan Widiyati, E. (2022). Sosialisasi pemanfaatan ekstrak ubi jalar ungu dan bunga terompet ungu sebagai indikator untuk mendeteksi boraks dan formalin pada makanan. *Martabe: Jurnal Pengabdian Kepada Masyarakat, 5*(3), 1018-1023.

[6] Gardjito, M., A. Djuwardi, E Harmayani, (2013). Pangan Nusantara.Karakteristik dan Prospek untuk Percepatan Diversifikasi Pangan, Jakarta: Kencana Prenada Media Group

[7] Habsah. (2012). Gambaran pedagang mie basah terhadap perilaku penambahan boraks dan formalin pada mie basah di kantin-kantin Universitas X Depok Tahun 2012. Skripsi. Progran Studi Ilmu Gizi. Fakultas Kesehatan Masyarakat. Depok.

[8] Hasnah, N., (2018) Identifikasi Kandungan Formalin Pada Ikan Asin Yang Dijual Dikota Kendari Sulawesi Tenggara, Karya Tulis Ilmiah, Jurusan Analis Kesehatan, Politeknik Kesehatan Kemenkes Kendari, Kendari.

[9] Julaeha, L., Nurhayati, A., Mahmudatusa'adah, A., (2017) Penerapan Pengetahuan Bahan Tambahan Pangan Pada Pemilihan Makanan Jajanan Mahasiswa Pendidikan Tata Boga Upi, *Jurnal Kesehatan*, 5 (1): 17-25.

[10] Khaira, K. (2016). Pemeriksaan formalin pada tahu yang beredar di Pasar Batusangkar menggunakan kalium permanganat ($KmnO_4$) dan kulit buah naga. *Saintek: Jurnal Sains dan Teknologi, 7* (1), 69-76.

[11] Khairunnisa, N. (2019). Analisa formalin pada tahu mentah yang dijual di Pasar Aksara, Cemara dan desa Lau Dendan Medan.

[12] Langi, T.M., dan Oessoe, Y.Y.E. (2019). Bahan Tambahan Pangan. *Bahan Ajar*. Universitas Sam Ratulangi. *Jurnal Tarbiyah* STAIN Batusangka.

[13] Menkes RI. (2012). Peraturan Menteri Kesehatan Republik Indonesia Nomer 33 Tahun 2012 :Tentang Bahan Tambahan Makanan.

[14] Mukminah, S., Karimuna, L., dan Asyik, N. Analisis Kandungan Formalin Pada Siomay Tahu yang Beredar di Sekolah Dasar di Kecamatan Baruga Kota Kendari. *Jurnal Sains dan Teknologi Pangan*, 4(2).

[15] Nisa F., (2015) Perbedaan Efektifitas Ubi Jalar *(Ipomea Batatas L.)* Ungu dan Bahan *Disclosing Solution* (Bahan Kimia) Sebagai Bahan Identifikasi Plak.

[16] Nuhman dan Wilujeng, A. (2017). *Pemanfaatan Ekstrak Antosianin Dari Bahan Alam Untuk Identifikasi Formalin Pada Tahu Putih*. Universitas Hang Tuah, Surabaya.

[17] Priska, M., Peni, N., Carvallo, L., dan Ngapa, D.Y. (2018). Antosianin dan Pemanfaatannya. Cakra Kimia (Indonesian E-Journal of Apllied Chemistry). Volume 6, Nomor 2, Desember 2018.

[18] Rambe, P., Maarisit, W., Tombuku, J., dan Paat, V., (2022). Identifikasi Kandungan Formalin Pada Ikan Teri (*Stolephorus indicus*) di Pasar Tradisional Amurang. *Biofarmasetikal Tropis, 5*(1), 6-10.

[19] Rahmawati., (2017). Identifikasi Formalin Pada Tahu Yang Dijual Di Pasar Kota Kendari Propinsi Sulawesi Tenggara, Karya Tulis Ilmiah, Jurusan Analis Kesehatan, Polliteknik Kesehatan Kendari, Kendari.

[20] Rochmawati. (2019). *Keamanan Pangan.* Yogyakarta: Penerbit Deepublish.

[21] Rochyani, N., dan Akbar, M. R. (2017). Pembuatan Media Uji Formalin dan Boraks Menggunakan Zat Antosianin dengan Pelarut Etanol 70%. *Jurnal Redoks*, *2*(1), 28-35.

[22] Saati, Elfi, A., Asiyah, R., dan Ariesandi, M. (2016). *Pigmen antosianin: Identifikasi dan Manfaatnya bagi Industri Makanan dan Farmasi*. Penerbit Universitas Muhammadiyah Malang: Malang.

[23] Safitri, AR. (2015). *Gambaran Pengetahuan, Sikap, dan Perilaku Penjual Tahu Mengenai Tahu Berformalin di Pasar Daerah Semanan Jakarta Barat Tahun 2015*. (Skripsi). Jakarta. Program Studi Kesehatan Masyarakat, Fakultas Kedokteran dan llmu Kesehatan : Universitas Islam Negeri Syarif Hidayatullah.

[24] Saptarini, M., Yulia, W., Usep, S., (2011). Deteksi Formalin Dalam Tahu Di Pasar Tradisional Purwakarta, *Jurnal Kesehatan*, 12 (1): 1-11.

[25] Rostina, R., dan Stientje, S. (2020). Identifikasi Formalin Pada Tahu di Pasar Tradisional PA'Baeng-Baeng Kota Makassar. *Sulolipu: Media Komunikasi Sivitas Akademika dan Masyarakat*, 2020, 20.2: 291-294

[26] Sulastri, Y., Zaini, M. A., Zainuri, Z., Wisyasari, R., Nofrida, R., dan Rahayu, N. (2019). Peningkatan Pemahaman Tentang Mutu dan Keamanan Makanan/Jajanan Bagi Siswa SD di Mataram. *Prosiding Pepadu, 1*, 401-407.

[27] Winarno, F.G. (2014). Kimia Pangan dan Gizi. PT. Gramedia Pustaka Utama, Jakarta.