

## REVIEW: THE USE OF TOFU RESIDUE IN THE PHARMACEUTICS

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### ABSTRACT

Tofu is a processed soy product consisting of soft solids made by clumping soy protein extracts. The residual result of tofu processing is called the tofu dredging waste. In Indonesia, tofu waste remains an unsolved problem. Many people argue that the waste from tofu processing (tofu residue waste) does not have high economic value and is only used as feed for livestock and is even thrown carelessly into the river, which causes damage to the ecosystem. Tofu pulp has high nutritional content, such as protein (26.6%), fat (18.3%), carbohydrates (41.3%), phosphorus (0.29%), calcium (0.19%), iron (0.04%), and water (0.09%). The purpose of this journal review is to determine the use of tofu residue waste and solve the problem of tofu residue waste in the community. The method used was collecting various research journals through the Google Scholar website with keywords for the use of tofu residue in the pharmaceutical field. Based on the 7 journals reviewed, tofu pulp can be used as an anti-aging, adsorbent, anti-diabetes, anti-inflammatory, bioethanol, and excipient in tablet production.

**Keywords:** Tofu, tofu residue, pharmaceutical

### INTRODUCTION

Tofu is commonly consumed in Indonesia. The BPS data on average per capita tofu consumption per week was 0.157 kg in 2017. High consumption of tofu produces a large amount of tofu waste. The water content in tofu pulp is very high, approximately 89.88% (Prayekti and Sumarsono, 2019).

Tofu is a processed soy product made by clumping soy protein extracts. According to SNI 01-3142-1998, tofu is defined as a food product consisting of soft solids made through the processing of soybean varieties (glycine), depending on how the protein is bound with or without adding other ingredients that are allowed. Quality tofu processing processes, cultivars, and quality soybeans and coagulants are used. The manufacture of know-how consists of two main stages: (1) the manufacture of soymilk and (2) the hardening of soymilk to produce a white precipitate (Andarwulan *et al.*, 2018).

Tofu is preferred by ordinary Indonesians people prefer tofu because of its high protein content. The raw material was soybeans, which are easily found in Indonesia. Tofu is famous for cooking, and is processed into several attractive foods and snacks. These trends suggest an increase in tofu production in the home industry. This tendency was correlated with the residue being a side production of tofu. Many home industries have developed methods to produce food from tofu. When tofu production rises, the residue of tofu becomes a problem in the environment, such as odor from liquid, air, and solid waste (Bundrant and Sellmann, 2021). Indonesia has approximately 84,000 tofu manufacturing industries. The

tofu industry in Indonesia produces approximately 2.56 million tons of soybean per year. According to these data, each tofu-making industry produces approximately 1,024 million tons of tofu drug waste per year (Endarwati, 2020).

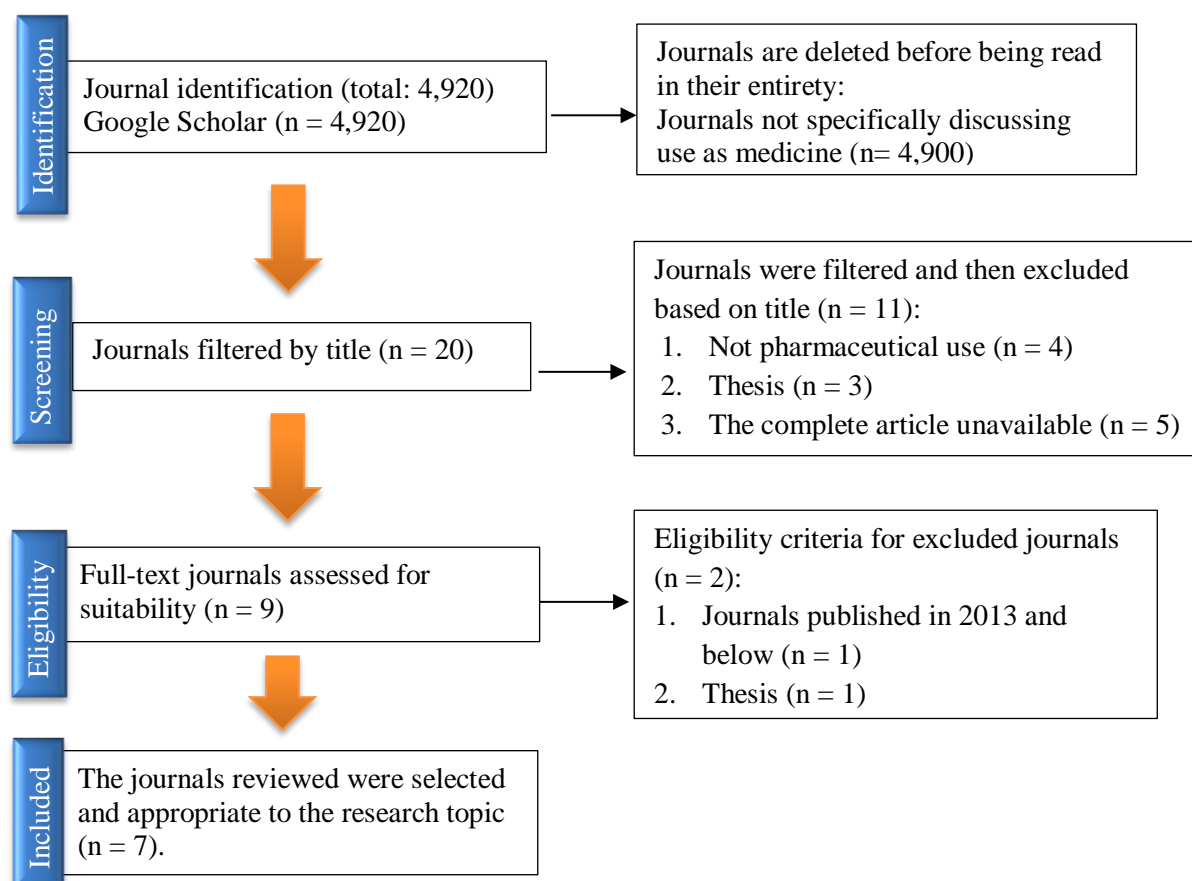
Tofu waste is a residue processed from tofu. Tofu residue waste has low economic value because not many people can use it more creatively; most people only use tofu residue waste as animal feed (Rahardjo et al., 2017). Tofu waste can become waste that disturb society if it is not processed properly or disposed of carelessly, pollutes the environment, and causes many diseases (Nur Anggraeni and Rahmiati, 2016). So far, tofu drug waste has not been optimally utilized by the community (Rahmina et al., 2017). Tofu residue waste is significantly profitable if it is processed through a recycling process or converted into daily life, either in the food sector or other fields that are useful and have benefits, and can increase the economic value of tofu residue waste itself (Dian pratiwi and Yamsuwirman, 2021).

The content of tofu residue waste is high in nutrients, such as 26.6% protein, 18.3% fat, 41.3% carbohydrates, 0.29% phosphorus, 0.19% calcium, 0.04% iron, and water. 0.09% (MD et al., 2019). These results show that tofu residue waste can be recycled by utilizing one of these contents, such as the high carbohydrate content, so that tofu residue waste can be processed as starch, where starch can be used as an excipient for pharmaceutical preparations (Sari et al., 2017). In addition, based on evidence from people's experiences, soybeans have benefits as inhibitors of aging. Soy or tofu residues contain isoflavone compounds that have been proven to inhibit premature aging of the skin (Lubis et al., 2022). The protein in the tofu residue waste can also be used as an absorption medium because it has the ability to absorb amino acids. Proteins can also bind metal ions or other compounds (Tanasale et al., 2020).

Many types of waste can be recycled or converted into other useful products such as waste from the food industry. The products of the processing were tofu, soy residue, and soymilk. Tofu residue, also known as soybean residue, can be used as a cosmetic ingredient. The residue is known to have a high nutritional content because, in the manufacturing process, not all parts of the protein can be extracted, especially when using a conventional and simple grinding process. Soy is considered healthy based on empirical evidence. Society can brighten, smoothen, and rejuvenate the skin (Lubis et al., 2022).

## RESEARCH METHOD

The method used in this journal review was to collect research journals from the Google Scholar site with the search keyword "Use of tofu residue in the pharmaceutical field." A clear statement regarding the journal search flow in Figure 1 has been adapted to the Preferred Reporting Items for Systematic and Meta-analyses (PRISMA) method scheme, including identification, filtering, eligibility, and obtaining journals that will be reviewed. The suitability of the journal obtained is based on the inclusion criteria, namely, journals that discuss the use of tofu drugs in the pharmaceutical field. Meanwhile, the exclusion criteria in this journal review were that the journal does not specifically discuss the use of tofu drugs in the pharmaceutical field, the thesis is incomplete, and the journal text cannot be accessed. This journal review aims to expand public knowledge about the use of tofu waste and to develop existing journals by combining and evaluating facts from valid and accurate scientific sources to obtain new information. Mendeley was used to create the citations and bibliographies. This journal discusses the use of tofu waste in the pharmaceutical sector, as shown in Table I.



**Figure 1. Screening Article Process**

## RESULTS AND DISCUSSION

This journal review aims to provide information about the use of tofu residues in the pharmaceutical field. This review suggests that decreasing environmental pollution because the smell of tofu residue is powerful and contaminates the environment, such as land or rivers. In addition, the amount of nutrients still contained in the tofu residue is due to its use as a food preparation with high nutritional and economic value.

Ordinary people suggest that tofu residue should no longer be used because it has an uncomfortable odor. In addition, tofu residues are potentially contaminated by microorganisms. However, several universities have developed research on tofu residue because of its nutritional value. When the tofu residue was dried, the smell and microorganisms were reduced. This residue has high carbohydrate and protein contents. This result underlies the use of tofu in pharmacies or cosmetic products.

**Table I. The Use of Tofu Residue In Pharmacy**

Reference	Product	Application
(Lubis et al., 2022)	Tofu residue powder	Anti aging
(Tanasale et al., 2020)	Tofu residue	Adsorbent
(N et al., 2020)	Tofu residue	Anti Diabetic
(Zulichatun et al., 2018)	Tofu residue	Dye Adsorbent
(Sukaryo et al., 2022)	Tofu residue	Bioethanol
(Sari et al., 2017)	Tofu residue	Anti-inflammatory
(Halik et al., 2022)	Tofu residue	Excipients

Some people believe that tofu residue is useless because it is just waste and no longer has economic value because of its unpleasant aroma. However, several studies have shown that tofu residue can be reused as a food processing material. This was performed to decrease environmental contamination.

Tofu residue is a solid waste produced from the tofu industrial waste. When soya milk was obtained by pressing milled soya beans, the residue was obtained. This residue still has high protein, carbohydrate, and mineral contents. This high nutritional value underlies the reuse of the residue as a nutritional food product.

Research results obtained from (Lubis *et al.*, 2022) showed that tofu residue contains compounds almost the same as the estrogen hormone, namely the isoflavone compound, which has been proven to act as a natural antioxidant in reducing premature aging. The formula with the most effective activity is a ratio of tofu residue and palm fruit 1:2 and has a pH value of 5.9, with the highest activity in preventing facial skin aging. This formula has a spreadability of 6 cm, adhesive power of 14.43 seconds, and drying time of 17.67 minutes. It is homogeneous, does not irritate, and is stable during long-term storage.

The results of the interpretation of data obtained from Tanasale *et al.* (2020) state that the use of tofu residue as an absorbent is necessary because tofu residue still contains a large amount of protein, which has absorption capacity. The tofu residue was prepared as a 100-mesh powder under dry conditions. If the water content is more significant, the ability of the absorbent to trap the absorbent is minor. In this study, the water content of the tofu residue after the drying process was 5.03%, indicating that the tofu residue could be used as an absorbent medium. The chemisorption process occurs between the absorption of the tatrazone dye and the tofu residue waste adsorbent. Research (Winda 2016) states that chemisorption is the chemical interaction between absorption and the adsorbent, which forms chemical bonds and improves the interaction between the two substances.

In vivo study in mice evaluated the effect of the ethyl acetate fraction of the tofu residue on blood glucose levels. Tofu was extracted by using 70% ethanol and HCl. The fraction was prepared using ethyl acetate. This fraction yielded water and ash contents of approximately 35.37% and 12.79 %, respectively. this fraction also contain the isoflavones, namely genistein and daidzein, 65.93 mg/100 g and 63.68 mg/100 g, respectively (N *et al.*, 2020).

Another finding is the ability of tofu residue to reduce the concentration of Crystal Violet (CV) and Congo Red (CR), underlying the use of tofu as an absorption agent called tofu residue activated carbon. Tofu residue activated carbon (TRAC) was obtained by drying and burning the tofu residue until charcoal (carbon) was obtained. The tofu residue was activated by the adding of 3M H<sub>3</sub>PO<sub>4</sub> to remove minerals. Combustion carbon activated by H<sub>3</sub>PO<sub>4</sub> leads to erosion, resulting in pores. These pores increased the absorption capacity of the tofu residue. This method resulted in a moisture in TRAC about 3.17%, 8.31 %, 6.61 %, and 81.89% in TRAC, ash, humidity, and carbon, respectively. The tofu residue did not meet these requirements because of the large amount of impurities in the ash. Furthermore, quantitative tofu residue activated carbon testing using FT-IR showed the presence of C-H deformation, O-H, and C=O groups, and several new absorption bands. Optimal absorption of Crystal Violet (CV) occurred at 75 minutes with PH 5 and Co = 8 mg/L at 98.41%, and optimal absorption of Congo Red (CR) occurred at 60 minutes with PH 5 and Co = 25 mg/L at 71.97% (Zulichatun *et al.*, 2018).

Another study reported research with the results that tofu residue solid waste is a home industry waste in making tofu, which can be used to make alcohol. The tofu residue had a carbohydrate content of approximately 26.9%. This carbohydrate content is fermented with the help of the microbe *Saccharomyces cerevisiae* and glucoamylase. The more

glucoamylase enzymes that are added, the more alcohol is obtained. The longer the fermentation time, the more bioethanol that is formed (Sukaryo *et al.*, 2022).

Research from Sari *et al.* (2017) found that tofu residue still contains high carbohydrates after undergoing the soybean pressing process, which is characterized by a brownish-red color change after being dripped with iodine, so it has the potential to be reprocessed into an excipient in pasta preparations. This study used several formulas to determine how effectively tofu residue could be used as an excipient. The formula that has a practical value is the ratio of tofu residue to starch of 1.25:1.25, has a PH value of 4.5–6, which indicates that this formula does not cause irritation to the skin, has a spreadability of 4.85–5.7, has an adhesive power of more than 1 second, and increases during storage. A one-way ANOVA test showed that tofu dreg starch could be used as an excipient in pasta preparations to replace the excipient starch binding agent (Sari *et al.*, 2017). Tofu residues are used as tablet fillers because they are high in carbohydrates, as proven by the iodine test, which produces a red color indicating the presence of carbohydrates. This is characterized by a color change of the tofu residue starch to red, indicating that the starch contains more amylopectin than amylose. The CTM formula, which has the best quality evaluation, contains 4 mg chlorpheniramine maleate, 62% tofu residue starch, 34% advice PH 102, 1% stearate, and 2% talcum. It has a PH of 5.41 (acidic atmosphere), water content of 5.60%, and ash content of 2.73% (Halik *et al.*, 2022).

Based on the 7 journals reviewed, tofu residue can be reused because of its higher nutritional value, namely protein, fat, and carbohydrates. Therefore, tofu residue was reused to avoid environmental pollution and increase economic value.

Utilizing tofu residue is an effort to reduce waste that is usually thrown into rivers so that it can cause environmental damage and the growth of many diseases. Environmental damage and diseases that will occur include polluted river water, unpleasant odors, cloudiness, overgrowth of bacteria and microbes, and skin diseases when used for bathing.

## CONCLUSION

The conclusion from a review of this research journal is that tofu residue is waste from processing tofu, which contains a large amount of protein, carbohydrates, and fat. If used according to the correct methods and procedures, it can be reused in the pharmaceutical field, including as an anti-aging, anti-inflammatory, anti-diabetic, absorbent, bioethanol, and excipient. With research on the use of tofu residue waste, we can address the problem of disposal of tofu residue waste.

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