AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

J. Bangladesh Agril. Univ. 11(2): 307–312, 2013 **ISSN 1810-3030**

Standardization parameters for production of tofu using WSD-Y-1 machine

M. F. Jubayer*, M. B. Uddin and M. O. Faruque
Department of Food Technology and Rural Industries, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh, *Email: fahadbau21@hotmail.com

Abstract

The present work was aimed to standardize different parameters for tofu production using the WSD-Y-1 machine. For this purpose the coagulant variation for production of tofu, shelf life of produced tofu as well as capacity of different parts of the WSD-Y-1 machine was determined. Soybean sample was collected from the Givency Pvt. Ltd., Gazipur. Soymilk was prepared by using the WSD-Y-1 machine. Seven tofu samples were prepared by using different coagulants ($CaSO_4$, $MgSO_4$). TSS variation of the milk was also made. The storage stability of tofu was observed at both room temperature and refrigeration temperature. The yield of tofu varied with coagulants. It was observed that the calcium sulfate gave more yield than magnesium sulfate when the use of both of the coagulants exceeded the single use. Tofu can be kept fresh under water up to one and half of a day and in the refrigerator up to ten days. The operating system of the WSD-Y-1 machine was standardized carefully. There were three operating parts: grinding, heating, and pressing. The grinder was capable to grind about 12-13 kg soybeans at a time. About 45 liter of milk can be heated in the heating system while in the pressing system about 14 liter of milk can be kept for pressing at a time. In this experiment about 1.2 kg of tofu was produced from 1 kg of soybean. On the basis of the work it is recommended that good quality of tofu can be prepared by using the WSD-Y-1 machine which is superior in quality to the hand-made ones.

Keywords: Tofu, Soft tofu, Soybean, Soymilk, WSD-Y-1 machine

Introduction

Soybeans are legumes that are grown for oil and protein around the world. Although classified as a bean, a soybean is actually an oilseed like the peanut. Soybeans are primarily consumed by humans after being fermented and turned into a curd. Tofu, a bland, cheese-like substance made from the whey of fermented soybeans, is the most common example of this kind of soy-product. Cravens and Endre (1958) reported the amino acid content of soybean. They observed isoleucine 4.5%, leucine 7.8%, lysine 6.4%, methionine 1.3%, cystine 1.3%, phenylalanine 4.9%, tyrosine 3.1%, threonine 3.9%, tryptophan 1.3%, valine 4.8%, arginine 7.2%, histidine 2.5%, alanine 4.3%, aspartic acid 11.7%, glutamic acid 18.7%, glycine 4.2%, proline 5.5% and serine 5.1%.

Tofu is the most popular among all soy products also called soy paneer and bean curd. It is a tasty and very nutritional product made by coagulating hot soymilk with some food grade chemicals such as calcium chloride, magnesium chloride, calcium sulfate, acetic acid and citric acid. Hou *et al.* (1997) conducted a study and concluded that Tofu made with calcium sulfate consistently produced higher yields of tofu per pound of soybeans than Nigari. Abd Karim, Sulebele, Azhar, and Ping (1999) reported that calcium sulfate had been used in China for 2000 years to coagulate soy milk to make tofu. It might be combined with magnesium sulfate as a tofu coagulant. Tofu is the perfect and least expensive substitute of milk cheese and paneer. Nutritionally its protein is as good as the protein derived from the animal sources. It is a component in many East Asian and Southeast Asian cuisines. However, the main health benefits of tofu will show up in significantly lower total cholesterol, triglycerides and low-density lipoprotein (bad cholesterol) if one eats tofu regularly instead of meat. Hence, the primary health benefit of tofu is to lower risk of atherosclerosis, hypertension and cardiovascular diseases.

Nine processing factors had been found to influence tofu yield and quality: 1) the water to soybean ratio, 2) the soaking time and temperature of the soybeans, 3) the grinding processing 4) heat processing and the heating rate, 5) the stirring speed at various points in the process, 6) the coagulation temperature, 7) the type and concentration of the coagulants, 8) method of adding the coagulant to the soymilk, and 9) the weight and time of press of the curds(Wang & Chang, 1995).

As Bangladesh is a developing country, most of the population is suffering from malnutrition. Protein supply from meat and fish is going beyond the buying capability of most of the people now-a-days. In such situation Tofu, which is very easy to prepare and consume, can play an important role to improve the protein deficiency among our population.

WSD-Y -1 machine is a product of Beijing Louke Machinery Co. Ltd. The machine produces bean curd, soybean milk, and un-coagulated been curd through heating soybean milk with high temperature steam. It is suitable for making soybean food in any place such as schools, armies, food markets, residential areas and supermarkets. The objectives of our work were:

a) To evaluate the effect of coagulant on tofu production
b) To observe the yield of tofu based on coagulant use
c) To evaluate the shelf life of tofu produced by WSD-Y-1 machine
d) To standardize the method and output of the WSD-Y-1 machine employed for Tofu production

Materials and Methods

Site of experiment

The experiment was conducted at the laboratory of Food Technology under the department of FTRI, Bangladesh Agricultural University, Mymensingh during the period from 14 July, 2012 to 03 December, 2012. The WSD-Y-1 machine was set there along with all other facilities.

Collection of raw materials

Freshly harvested soybeans were collected from the Givency pvt. Ltd. The beans were packed 2 kg accordingly and stored in refrigerator. Aluminum foil was used for packaging. Chemicals and solvents required for the work were of analytical reagent grade as well as the water was glass distilled unless specified otherwise. Other ingredients were used from laboratory stocks.

Pretreatment of soybean seeds

Mahawanich (1995) reported that the temperature of the water used determines how long the soybeans must be soaked. As the temperature of the water goes down, the soaking time increases, and vice versa. The seeds were soaked about 12-14 hours in water before operation. Soaking softened the seeds for grinding and extracting milk. The seeds had gone through blanching for 5-10 minutes before grinding. The weight of the soybean seeds changed due to soaking. For removing odor the seeds were treated by sodium bi carbonate in hot water for about 30 minutes.

General procedure of making tofu

1) Selecting the soybeans
2) Cleaning the seeds (Soybeans)
3) Soaking the soybeans
4) Removing the testa (from the soybeans)
5) Making soybean milk
6) Simmering the soymilk
7) Cooling the soymilk
8) Curdling the milk (Making tofu cards)
9) Pressing the curd
10) De-boxing the finished tofu

Operation with WSD-Y-1 machine

The WSD-Y-1 machine has an effective grinding and heating system operated by electricity. The soybean seeds were supplied manually as well as the water to the boiler. When the seeds were supplied to the grinder, water was supplied to facilitate grinding. The stone was to be set in a way that friction with the wall was minimal. Otherwise it could have broken. The grinding action accelerates with the rotating of

circular stone along with the wall. While grinding, the soymilk was obtained and stored in the heating chamber. The byproduct was collected in a big dish. There were four operating switch. The starting switch, another two for the heater, and switch for grinder. Normally the two switches for heater were switched on for the primary heating. When the temperature raised above 110° C then one of them was switched off. It was required to keep the temperature in the range of 90 C to 100 C. Then the milk was obtained for further operation through a discharge line. When the temperature of milk got down to 70-75 C the coagulant was mixed with the milk. After that, the mixture was kept until total coagulation took place. It took about 45 minutes to the whole coagulation of milk. Then the coagulated milk was placed in the pressing section for removing of water. A fine coarse cloth was placed on the shaping box and the coagulated milk was poured onto it. Then the milk was covered by the cloth and pressed until the wheel got tightened.

Formulation of tofu

The basic formulations used for preparation of tofu are outlined in the following Table. The basic formulation of tofu has been adapted from the recipes reported by Niyomvit (1983).

Table 1. Formulation of tofu

Types of tofu	Coagulants	Amount of coagulant used (% wt of soybean)	Temperature at which the coagulants to be applied (°C)
Hard tofu	$MgSO_4$	2.2	70-75
	Glucono delta lactone	3.0	90
	Vinegar	16.3	70
Soft tofu	$CaSO_4$	2.7	70
Packaged tofu	Lactone	1.1	85-90
	$MgCl_2$	1.8	90
Firm tofu	$CaSO_4$	8	90
	$MgSO_4$	2	70

Result and Discussion

Standardization of the process

Grinding operation

Grinding of soybean in WSD-Y-1 machine

Amount of bean that can be grinded at a time: 12-13 kg soybeans
Stone adjustment condition: No friction with the grinder wall is allowed, only a little friction is allowed
Advantages:

1) Uniform grinding
2) Good amount of beans can be grinded
3) Additional stone available in case of emergency
4) Way out for the byproduct
5) Easy to clean
6) Good separation system of milk and byproduct

Disadvantages:

1) Too much tight setting often breaks the stone
2) Soybean has to be supplied manually to the grinder
3) Stone attachment has to set manually

Heating operation

Heating operation in WSD-Y-1 machine

Minimum amount of milk required to start heating: 10 liter
1st Heating: Up to 105^{0}C

Constant heat: 95^0C for 20 minutes
Water level for boiler: Up to the Green mark in the water level indicator
Advantages:

1) Proper temperature can be maintained
2) There are two heaters for proper heating
3) Supply line for water to boiler is good
4) Single heater can be run
5) Water level indicator
6) Pressure gauge
7) Direct supply of steam to heating chamber

Disadvantages:

1) As the steam supply pipe is some distance above in the heating chamber, so it is not possible to heat the milk until the pipe is submerged by milk
2) Foam occurred during heating is to removed manual

Pressing operation

Pressing of tofu in WSD-Y-1 machine
Capacity: 14 liter of milk
Advantages:

1) Water drainage system after pressing is available
2) Pressing is uniform

Disadvantages:

1) Pressing to be done manually
2) Capacity of press block is less

Maximum limit of materials that can be used

1) In the grinding section, maximum 12-13 kg of soybeans can be grinded at a time
2) In the heating section, maximum 45 liter of soymilk can be heated at a time
3) In the pressing section, maximum 14 liter of soymilk can be pressed for tofu production

Yield of tofu with coagulant variation

The yield of tofu varied with coagulant. Yield of tofu prepared by using different coagulants is shown in the Table 2. TSS is also employed. Maximum yield was found by using calcium sulfate and magnesium sulfate together. Other data is as indicated in Table 2.

Table 2. Yield of tofu based on TSS and coagulants variation

Amount of soybean(kg)	Milk obtained (liter)	TSS of soymilk	Coagulant used		Amount of tofu (kg)	Yield/kg
			Coagulant	Amount (gm/L)		
2	10	6	$CaSO_4$	2.8	2.30	1.15
2	10	6	$MgSO_4$	2.2	2.25	1.10
2	12	4	$CaSO_4$ + $MgSO_4$	8+2	2.35	1.175
2	10	6	$CaSO_4$ + $MgSO_4$	8+2	2.40	1.20
3	13	8	$CaSO_4$ + $MgSO_4$	8+2	3.30	1.10
3	12	9	$CaSO_4$ + $MgSO_4$	8+2	3.50	1.167
3	11	10	$CaSO_4$ + $MgSO_4$	8+2	3.75	1.25

Yield of tofu with TSS variation

Yield of tofu with different TSS is shown in the Table 2. We carried out our experiment at different TSS and observed the yield. Also there was the effect of coagulant. We have found that higher TSS results in a higher amount of tofu. For the same amount of soymilk, if TSS difference is one, that will cause about 100-200 gm difference.

Change of weight after soaking

Soybeans were soaked in water for about 12-14 hours before operation. That made the beans very soft to grind, as the primarily obtained soybeans were too hard to grind and extract milk. We found that the weight of the soybeans changed to double after soaking. The water used at the time of grinding was 2 liter/kg of initially weigh soybean.

Table 3. Weight change due to soaking

Sample	Water used for soaking (L/kg)	amount of soybean (kg)	Weight change		Increased wt/kg	Average increased wt/kg
			Before(kg)	After(kg)		
Soybean seed	8	1	1	2.1	1.1	1.008
		2	2	4.05	1.025	
		3	3	6.0	1	

Storage studies of tofu

During storage the appearance as well as color, taste and flavor were evaluated in 24 hours interval as indicated in Table 4 and Table 5. The sample which was kept under water found fresh up to one day of storage. But at refrigeration temperature the tofu sample hold its freshness up to 10 days.

Table 4. Observation of storage stability of tofu at room temperature

Type of condition	Day	Sample	Temperature (room temperature)	Texture	Flavor and taste	Remark
Under water	1	T1	25^0C	Soft tofu	Pleasant	Acceptable
Under water	2	T1	25^0C	Soft tofu	Slightly rancid	Nearly acceptable
Under water	3	T1	25^0C	Soft tofu	Deterioration in color, flavor and taste	Not acceptable

Table 5. Observation of storage stability of tofu at refrigeration temperature (5^0C)

Day	sample	Texture	Flavor and taste	Remark
1	T1	Soft	Pleasant	No change in color, flavor and taste, so acceptable
2	T1	Soft	Pleasant	
3	T1	Soft	Pleasant	
4	T1	Soft	Pleasant	
5	T1	Soft	Pleasant	
6	T1	Soft	Pleasant	
7	T1	Soft	Pleasant	
8	T1	Soft	Pleasant	
9	T1	Soft	Pleasant	
10	T1	Soft	Pleasant	
11	T1	Soft	Unpleasant	Slight change in color and flavor
12	T1	Soft	Unpleasant	Taste changes
13	T1	Soft	Unpleasant	Development of odor and becomes uneatable

Conclusion

From the effort made on the work, it was observed that good quality of tofu can be prepared using the WSD-Y-1 machine. The WSD-Y-1 machine is quite good for the beginners as well as a good system for preparing tofu at home condition. Different standard parameters were set along with the advantages and disadvantages. The quality, appearance, texture of the prepared tofu produced by the WSD-Y-1 machine was completely higher than manually prepared one. Beside this, it was observed that calcium sulfate gave more yield than magnesium sulfate. But when both of the coagulants were used combined the yield of tofu was much more than the use of single coagulant. On the other hand, tofu stored under water was seemed fresh up to one and half a day, while the storage in the refrigerator showed a shelf life for three and ten days respectively. As for suggestions, further improvement can be made in the pressing section of the machine by providing different size of press box.

References

Abd Karim, A., Sulebele, G.A., Azhar, M.E. and Ping, G.Y. 1999. Effect of carrangeenan on yield and properties of tofu. Food Chemistry 66: 159-165.

Cravens, W.W. and Endre, S. 1958. In processed plant protein food stuffs. Edited by A.M. Altschul, Academic press.Inc., New York. P 372.

Hou, H.J., Chang, K.C. and Shish, M.C. 1997. Yield and textural properties of soft tofu as affected by coagulation method. Journal of Food Science 62: 824-827.

Mahawanich, Thanachan. 1995. Effect of processing and handling variables on the shelf stability of packaged Tofu. Thesis for Master of Food Science Program at the University of Illinois, Urbana- Champaign.

Niyomvit, N. Soymilk and soy milk products. In the proceedings of a workshop on soybean. Consuming campaign in 1983, held at the New Imperial Hotel, Bangkok during 1-3 April, 1983: 35-36

Wang, Chang. 1986. Texture and microstructure of soybean curd (tofu) as affected by different coagulants. Food Microstructure 5: 83-89.