

# A Study of Tepary Bean and Soybean Combination Curds and Their Textural Characteristics

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## Tepary Bean과 Soy Bean 혼합두부의 제조 및 품질 특성에 관한 연구

장 경 정

적 요

Tepary bean (*phaseolus acutifolius var latifolius*)은 반사막성기후 즉 미국의 서남부나 멕시코에서 자라는 콩으로 이 콩의 curd 생산에 있어서의 acceptability를 조사하는데 목적을 두었다.

Curd는 100% Tepary bean (TB)과 soybean (SB)의 여러가지 비율의 혼합물을 University Arizona와 Unicon Valleage Company와의 Cooperative Extension work에서 연구된 방법을 적용하여 만들었다.

완성된 curd는 무게와 충고성분의 양(Yield)을 측정하였고 관능검사결과를 통계처리하여 특성 및 acceptability를 조사하였다.

TB:SB가 50 : 50 그리고 25 : 75의 비율일때, curd 제품의 관능검사와 acceptability에서 만족할 수 있었다. 따라서 50% 이상의 Tepary Bean Tofu는 좋은 질의 curd로서의 생산 이용 가능성이 없는 것으로 판단되어 50% 미만의 Tepary Bean과 Soy bean의 curd는 서로 제한 아미노산을 보충 해주어서 보다 좋은 질의 TOFU를 생산할 수 있는 가능성을 가졌다고 보여진다.

### I. INTRODUCTION

Soybean curd (called tofu) is one of the important nonfermented soybean products which has been widely used in a variety of dishes as a basic food by oriental people for many centuries, is gaining popularity throughout the world.

This is a highly digestible and nutritive product and it also serves for human as an inexpensive high

protein source, low calories, lack of cholesterol and ease of cooking with other foodstuffs.

According to their moisture content and texture, tofu can be divided into three basic types; soft, medium and hard tofu. In addition to regular tofu, there are some processed tofus, such as deep-fried tofu, frozen tofu and fermented tofu. Tofu texture varies markedly among different types. For instance, it can be as hard and chewy as smoked ham or as soft and smooth as pudding. Usually, a tofu of

certain texture is chosen to meet a needed functionality in preparing a given dish. Also, the preference depends upon the individual habit as well.

The average protein content of soybean is usually considered as 40%<sup>1)</sup>. In addition to protein quantity, the quality of soybean protein is the best of the vegetable sources. According to the essential amino acid patterns<sup>2)</sup>, the balance of essential amino acids, except for methionine and cysteine in soy flour, corresponds to that in hen's egg protein. In case of teparybean, *phaseolus acutifolius var latifolius*, it is well known that early residents of the American southwest incorporated grain legumes, either wild or domesticated, into their daily diets, and contributed substantially to the nutritional well being of early settlers of both Spanish and Indian cultures, has remained an important food source for people of this area. The average protein of teparybean is 24.5% and limiting amino acids are phenylalanine and tryptophan. All beans studied were deficient in either tryptophan or sulfur containing amino acid and introduced teparies containing higher levels of cysteine/Methionine with commodity of pintos than reservation grown samples of either species<sup>3)</sup>. Soybean and teparybean have different limiting amino acid, therefore teparybean may be used to supplement soybean.

The nutritional value of teparybean seeds was brought to the human only recently. The need for the protein of edible food product with high nutritional quality of bean seeds has been studied. The purpose of this study was to investigate the probabilities of production of acceptable curd as a tofu from teparybean seed. combinations of teparybean and soybean were utilized to minimize production conditions. The objectives of this work can be categorized into 2 areas:

- (1) Preparation of "teparybean curd" using teparybean-soybean combinations.
- (2) Evaluation of texture of the prepared curds.

### 1. Production of curd

Traditionally tofu production involves two steps; A preparation of soymilk and coagulation of soybean protein in the milk to a curd. 3 cups of teparybeans and soybeans were soaked overnight in tap water at room temperature. 1 cup hydrated seed were placed in a warring blender together with two and half cups of water. The beans and water were blended for 2 minutes. The resulting slurry was filtered through muslin towel and squeeze and press soy pulp to obtain of soymilk. the soymilk was heated at medium high heat, stirring frequently to prevent sticking until begin to boiling. It takes about 20 minutes. Boiled for 2 minutes more and removed from heat and then one cup of coagulant was added slowly. Delicate curds began to separate from a clear, pale beige-yellow liquid. After 10 minutes, transfer the curds from the pot into the lined colander with muslin dish towel. Fold edges of cloth neatly over curds and put a flat plate on the top and apply pressure to mold curd. Set a weight (the small pot filled water) for one hour. For the preparation of teparybean (TB)-soybean (SB) combination curd, 3 cups beans were used in following percentage proportions on V:V basis. This method was developed by cooperative extension service with U.S. Department of Agriculture at the University of Arizona.

- (1) 50 : 50/TB:SB
- (2) 25 : 75/TB:SB
- (3) 1 : 100/TB:SB

### 2. Coagulants

3 teaspoons Epsom salt ( $MgSO_4$ ) : 2.7% for filtrate milk

3. Yield was expressed as grams of fresh curd from 100 ml boiled milk.

### 4. Chemical Analysis

AOAC (1975) procedures were used to determine

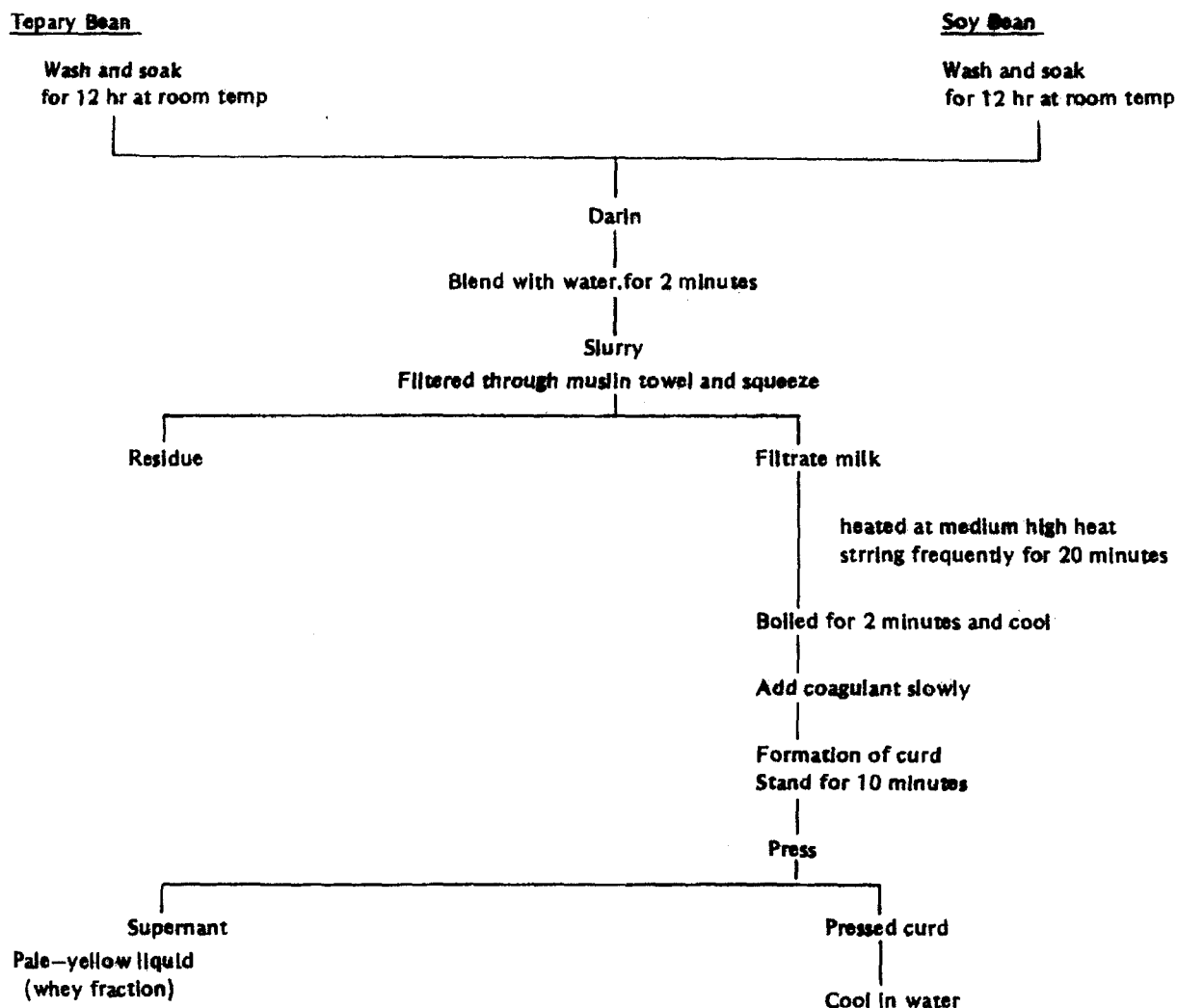


Fig. 1. Flow sheet the preparation of curd.

crud protein (kjeldahl,  $N \times 6.25$ ) and moisture contents of samples.

#### 5. Sensory evaluation<sup>4-6)</sup>

Sensory evaluation was carried out by an semitrained panel of 23 members. Curd samples were cut into  $1 \times 1 \times 2$  cm cubes of curds and were provided. One was for textural properties, the other was for mouth-feel and overall acceptability. A 11 to 1 scale and 5 to 1 scale were used to evaluate the parameters. A commercial tofu sample with a score of 6 in hardness, elasticity, choesiveness and mouth-

feel and 3 in overall acceptability on each sensory parameter was presented as the reference.

**a. Textural properties:** Panelists were asked to compress the curd with plastic spoon and evaluate hardness, elasticity and cohesiveness which were defined as follows:

(1) **Hardness**—force required to compress the curd with plastic spoon. If the sample is harder than the reference<sup>6)</sup> it would rate higher, if softer, lower (Maximum rate=11 Minimum rate)

(2) **Elasticity**—degree to which the curd returned to its original shape once it has been compressed with

plastic spoon. If the sample return faster than the reference<sup>6)</sup>, it would rate higher, if slower, lower (Highest degree=11, Lowest degree=1).

(3) Cohesiveness—degree to which the curd remained intact during the manipulation. Stir or mix the sample, what does it look like? If is less disturbed (greater cohesiveness), it would rate high, more disturbed, low (Highest degree=11, Lowest degree=1).

**b. Mouth-feel:** Felling of the curd in the mouth. The reference checked as a 6. If a product is more grainy, coarse, very rough, etc., it would rate lower. If a product were smoother (a desirable mouth-feel for tofu), it would rate higher. (Highest rate=11, Lowest rate=1).

**c. Overall acceptability:** The samples were ranked according to their preference and the highest score given is 5, the lowest score is 1, and reference score is 3.

## 6. Statistical analysis

The significance of the physical analysis as well as the sensory evaluation was estimated by analysis of variance (ANOVA) and the Least Significant Difference procedures.

## II. RESULT AND DISCUSSION

### 1. Yield

Various mixtures of teparybean and soybean were processed into curds. All curd products containing

soybean were firmer and more acceptable. It could be observed that, while weight of curd produced from either tepary bean or soybean and their mixture approximated 51~69% of boiled milk. As more increasing the mixed amount of soybean from 25 part to 100 part, it shows more suitable choices of firmness in preparing the TB & SB combination curds.

The range of moisture contents of the different combinations of curds in this study was 84.2~86.3% as evident by the range of solid content 13.7~15.8% (Table 1).

The range of protein in the curd samples from various combination was 8.2~9.0 g/100 g of fresh weight basis (Table 1).

### 2. Textural Evaluation

The acceptability of the curd product depends upon the physical-sensory properties. Table 2 (Attachment 1) shows the data obtained with regard to the several primary textural parameter of hardness, cohesiveness, elasticity, mouth-feel and overall acceptability.

In hardness, among the curd sample, the values for hardness was increased with increasing soybean protein content. And they have a significant ( $p < 0.05$ ) difference between 100% soybean curd and teparybean mixture curd. The variation in the texture and the production of teparybean curd in comparison to that of soytofu, may be attributed to the differences in the structure of storage globulin of teparybean.

Table 1. Yields, Solids, and Protein Content of Curd with Different TB & SB Combinations

Combination	Protein content (g/100g) of fresh wt. of curd	Solid percent (%) of fresh wt. of curd	Yield of curd (g) per 100ml of boiled milk
100 / TB	8.2	13.7	57.1
75 : 25 / TB : SB	8.4	14.3	51.4
50 : 50 / TB : SB	8.8	14.7	63.4
25 : 75 / TB : SB	9.0	15.6	69.0
100 / SB	8.9	15.8	63.2

\* Values are averages of at least duplicate determinations.

Table 2. Comparison of the Taste Panel Scores of Curds

Texture property Combination	Hardness	Cohesiveness	Elasticity	Mouth-feel	Overall acceptability
50 : 50 / TB : SB	4.15	4.54	4.62	6.23	2.15
25 : 75 / TB : SB	4.46	5.54	4.92	6.54	2.46
100 / SB	6.54	6.00	6.00	6.08	3.00
*Commercial	6.00	6.00	6.00	6.00	3.00

\* Commercial ; SB Tofu by Food Conspiracy Co. in Tucson.

TB ; Tepary Bean

SB ; Soy Bean

LSD (0.05) ; Means in the same column bearing different superscripts differ significantly at the 5% level N=23

Most legum seeds contain 2s, 7s, 11s and 15s storage globulin, and 11s and 7s proteins are the main<sup>7)</sup>.

Sato (1961) et al., investigated the food processing characteristics of tofu made from crude soybean 11s and 7s protein fraction. They observed that the tofu-gel from 11s fraction was remarkably harder than from crude 7s fraction<sup>7)</sup>. The platable hardness of whole of 7s and 11s component present in the soybean protein. It can be inferred that the soft nature of teparybean curd, in comparison to soytofu, as revealed by the measurement of hardness, may be due to the absence or lack of 11s fraction in teparybean protein.

In cohesiveness, it is also increased the cohesiveness with increasing soybean protein content, but they have no significant difference between samples at 1% level. At 5% level, they have a significant difference between 50% TB mixture curd and 100% SB curd.

In elasticity and mouth-feel, they also indicated that with increasing soybean content, increased the scores, but they have no significant difference at 5% level and 1% level.

The overall acceptability of the soybean and teparybean curds were compared, and the result is shown in Table 2.

The result showed that the panalists liked the commercial and 100% SB tofu sample than TB and SB combination tofu, but the difference was not

significant at 5% level and 1% level.

Therefore, these observations indicated that satisfactory curd product with acceptable textural properties can be made with two combinations 50 : 50 / TB:SB. The over 50% teparybean tofu could not be utilized for production of good quality curd, similar to that of soybean. In comparison with in vivo determinations of protein quality characterizing other grain legumes, PERS associated with tepary diet were low, but reflected the general performance of members of this family as protein sources<sup>9)</sup>.

Preliminary experimentation suggested increased PER values of obtained from tepary bean diet which had been supplemented with methionine<sup>9)</sup>. In this direction, further processing modification has to be more studied to investigate the possibility of producing a good quality curd from teparybean utilizing alternate technology and or different cultivars of teparbean with nutritional aspect.

## SUMMARY

For the probability of preparation of 100% Tepary bean or mixed soybean curd employing the steps of soy curd by Epsom salt ( $MgSO_4$ ) have been studied and optimized.

The curd characteristics includes weight, total solid content, and textural properties. The result showed that.

Satisfactory curd product with acceptable texture properties can be made with two combinations 50:50/TB:SB and 25:75/TB:SB. The over 50% Tepary bean Tofu could not be utilized for production of good quality curd, similar to that of sobean.

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