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To Study the Effect of Drying Methods on Physic-Chemical Characteristics of Fermented Soybean (*hawaijar*)

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ABSTRACT

The study was conducted to compare and study the feasibility and effect on nutritional properties of fermented soybean during storage at ambient and refrigeration conditions for which the soybeans were fermented through naturally fermenting strains. This study is an attempt to determine the chemical proximate analysis of *hawaijar* and the nutritional changes occurring during processing and storage in expectation that the data generated can be used as the nutritional reference and as the food regulatory standard. For comparative study the soybeans after fermentation were tray dried and solar dried and their nutritional properties were checked accordingly at varying intervals of 0day, 30 days, 60 days and 120 days. The physiochemical parameters namely (moisture, ash, protein, crude fiber and yeast and mold count) were evaluated on the successive days of storage to assess the durability to consumers. The physiochemical analysis showed that with the increase of storage period there was considerable increase in moisture content during storage i.e from 8.9% to 11.89%. But it was observed that the storage conditions do have a significant amount of loss of protein i.e. from 29.10% to 27.50%, and crude fiber i.e. from 6.52% to 4.28%. However there was little change in ash content during storage i.e from 1.30% to 1.28%. Samples that were stored in refrigerating conditions showed less loss. Moreover the effect of loss was observed maximum in the samples that were sun dried and the losses were found more in samples that were stored in ambient conditions. The microbiological study revealed even on the 120 days of storage the yeast and mold count was within permissible limit (7.8×10^2 cfu/g) and it was acceptable for consumption.

Keywords: Hawaijar, Textured Vegetable Protein, Bioproducts, VSAET, ACE

I. INTRODUCTION

The soybean (US) or soya bean (UK) (Glycine max) is a species of legume native to East Asia, widely grown for its edible bean which has numerous uses. The plant is classed as an oilseed rather than a pulse by the UN Food and Agricultural Organization (FAO). Fat-free (defatted) soybean meal is a significant and cheap source of protein for animal feeds and many prepackaged meals; soybean vegetable oil is another product of processing the soybean crop. For example, soybean products such as textured vegetable protein (TVP) are ingredients in many meat and dairy analogues. Soybeans produce significantly more protein per acre than most other uses of land. The production of soybean is increasing while the utilization remains low. There is a need to undertake sustainable indigenous fermented soybean development through value added fermented soybean products. North East India is treasure house of agricultural, horticultural crops and microbial resources. Soybean is a leguminous crop. It has been described as a miracle golden bean because of its nutritional composition. It is a rich pulse containing about 40% protein, 20% fat and 31% carbohydrate. Soybean protein is a good source of some essential amino acids such as lysine, tryptophan and threonine. Addition of soybean to staple crops will improve local diets. Soybean like some other legumes contains some anti -nutrients such as trypsin inhibitor and phytic acid. These anti - nutrients can be destroyed by heat especially moist heat during processing; hence soybean must be heat processed before consumption. Soybean can be used as (a) Whole soybean. It can also be incorporated into (b) cereals, (c) legumes, (d) root and tubers. The main producers of soybean are the United States (35%), Brazil (27%), Argentina (19%), China (6%) and India (4%). The beans contain significant amounts of phytic acid, alpha-linolenic acid, and isoflavones. Indigenous fermented foods form a major role in the daily food intake of north eastern regions of health India. A traditional fermented food made from soybean fermented with Bacillus subtilis, is most popular in Manipur, Nagaland, Arunachal Pradesh, Mizoram and Sikkim. After fermentation by microorganisms, the anti-nutritional factors in soybean or soymeal are totally degraded, including oligosaccharides, trypsin inhibitor and phytic acid. Fermentation could also degrade large soybean protein into peptides and amino acids, therefore, removing the allergenic effect of soybean protein. Nutritional factors are formed during fermentation along with removal of undesirable factors. Functional peptides, such as peptides with ACE inhibitory activity are created by protein degradation. Isoflavones are converted to their functional forms, the aglycones. Antioxidant activity is enhanced, contributedby the increase of short chain peptides and phenolic compounds. Certain vitamins or provi Soybean - Bio-Active Compounds 172tamins are formed such as riboflavin, β-carotene, vitamin K2 and ergosterol. Total nutritional profiles of soybean and soymeal are greatly enhanced by fermentation. Drying is a mass transfer process consisting of the removal of water or another solvent by evaporation from a solid, semi-solid or liquid. This process is often used as a final production step before selling or packaging products. To be considered "dried", the final product must be solid, in the form of a continuous sheet (e.g., paper), long pieces (e.g., wood), particles (e.g., cereal grains or corn flakes) or powder (e.g., sand, salt, washing powder, milk powder). A source of heat and an agent to remove the vapor produced by the process are often involved. In bioproducts like food, grains, and pharmaceuticals like vaccines, the solvent to be removed is almost invariably water. In the most common case, a gas stream, e.g., air, applies the heat by convection and carries away the vapor as humidity. Other possibilities are vacuum drying, where heat is supplied by conduction or radiation (or microwaves), while the vapor thus produced is removed by the vacuum system. Another indirect technique is drum drying (used, for instance, for manufacturing potato flakes), where a heated surface is used to provide the energy, and aspirators draw the vapor outside the room. In contrast, the mechanical extraction of the solvent, e.g., water, by centrifugation, is not considered "drying" but rather "draining". Moreover, since sun drying depends on uncontrolled factors, production of uniform and standard products is not expected. The quality of sun dried foods can be improved by reducing the size of pieces to achieve faster drying and by drying on raised platforms, covered with cloth or netting to protect against insects and animals. Allowable storage time is an estimate of how long the grain needs to be dried before spoilage and maintain grain quality during storage. In grain storage process, fungi or molds are the primary concern. Many other factors, such as insects, rodents, and bacteria, also affect the condition of storage. The lower the grain temperature is, the longer the allowable storage time will be. The drying cost is made up of two parts: the capital cost and the operating cost. Capital cost is largely depend on the drying rate requirement, and equipment cost. Operating cost refers to fuel, electricity and labor force cost. The amount of energy required to dry a bushel of grain is similar for all the drying methods. Some methods depend largely on natural air, while others may use LP heat or natural gas, which make energy cost vary. Basically, fuel and electrical power are the major portions of the operating cost.

II. METHODS AND MATERIAL

Fresh and healthy soybean and packaging material such as High-Density polyethylene was purchased from the local market of Allahabad, and brought to the laboratory in sterile polythene bags for use in the whole period of investigation. The effect of drying methods on physic-chemical characteristics of fermented soybean (*hawaijar*) was conducted in the Laboratory of Food Process Engineering Department, Vaugh School of Agricultural Engineering & Technology. . A number of equipment and apparatus were required to conduct the present study. These include Micro Kjeldahl, Soxhlet apparatus for fat estimation, Tray drier, Solar drier, Hot air over (Tango India), Laminar Air Flow, Muffle furnace for ash estimation, Autoclave and Heat sealing machine (Quick Seal, Sevana, India) etc. Firstly good quality soybean seeds were selected, washed and soaked overnight and then cooked until soft when pressed between thumb and index finger. Draining of cooked soybean seeds is followed by immediate cooling under running water and Packing is done in fig leaves or muslin cloth. Packed soybean seeds covered with paddy husk/straw in a bamboo woven basket followed by growth of Bacillus subtilis and natural fermentation. Now the moisture content maintained at 80% that result in the development of specific flavour. Fermented soybean product is then tray dried (60°C for 7 hours) or sun dried (for 4 days).

Experimental Set-Up

Table 1

Treatments	Description
T1	Fermented soybean tray dried stored at ambient temperature
T2	Fermented soybean tray dried stored at refrigeration temperature
T3	Fermented soybean sun dried stored at ambient temperature
T4	Fermented soybean sun dried stored at refrigeration temperature

Determination of Moisture content of snack food

10g of every snack food samples were weighed in flat bottom dried treated dish. The dish and its content were placed in hot air oven (Yorco Hot air sterilizer, India) which was thermo statistically controlled at I05±1°C and heated until successive weighing showed no further weight loss. At the end, the dish was removed from the oven and placed in a desiccator and allowed to cool and then again weighed.

Determination of Fat content of snack food

The Soxhlet method has been suggested by Association of Official Analytical Chemist (AOAC. 1971) was used for product fat extraction.

Determination of Total Ash content of snack food

Ash content represents the mineral matter present in the snack sample. Weigh accurately 5g sample in the dish previously dried in hot air oven. Heat dish gently on a flame at first and then strongly in a muffle furnace at 550 ± 10°C for 4 to 5 hrs. or until ash is formed. Cool the dish in the desiccators and weigh.

Determination of Protein Content of snack food

Protein was estimated according to micro kjeldahl method described in AOAC (1984).

Evaluation of sensory characteristics

Sensory attributes including color, flavor, texture, taste and crispness of snack food were evaluated by Hedonic Ratting Test as recommended by Ranganna (1994). Hedonic Rating test was used for evaluation of sensory characteristics. This test is used to measure the acceptability of consumer for the product.

Determination of crude fibre content.

The Soxhlet method has been suggested by Association of Official Analytical Chemist (AOAC. 1971) was used for product fat extraction using reagents like Dilute Sulphuric acid – 1.25% (w/v) accurately prepared, Sodium Hydroxide solution – 1.25% (w/v) accurately prepared and Ethyl alcohol – 95% by volume.

III. RESULTS AND DISCUSSION

Fermented soybean product (*Hawaijar*) is widely used as condiment with vegetables in north eastern regions of India. Although like other fermented soybean foods, *Hawaijar* is believed to be a good source of protein, there is a little information regarding the nutritional value and composition changes occurring during fermentation and storage. To elucidate further information on this, proximate composition of raw soybean seeds, soybean at different stages of fermentation and storage were determined and illustrated. The following experiment was conducted in departmental Lab. of (Dept. of Food Process Engg.) in VSAET. The results of conducted experiment were discussed under following headings:

1. **Physico-chemical characteristics of dried fermented soybean product (*hawaijar*) during shelf life study.**

2. **Effect of storage condition on moisture content (in percent) of dried fermented soybean (*hawaijar*) during storage.**

After fermentation the moisture content (%) of the product was found to be 55%, and its amount reduces as the drying of that product was done for enhancing the shelf life of products. Hence the effect of different drying methods, storage condition and period on moisture content of Hawaijar packed in HDPE is presented in Fig 1. On evaluation of the results, it was found that the moisture content of product was increases considerably during the storage period. The maximum moisture content was found in T_4 (product having sun dried & kept in Refrigerated condition) 10.74%. The increase in moisture content with the increase in storage period was comparatively more in product in refrigerated condition rather than ambient condition, due to hygroscopic nature of the fermented products. However the increase in the moisture was in specified range. On comparison of the results obtained by **Blandino *et al*.,(2003)** it was found in close similarity to the data obtained in the current study of fermented and dried soybeans. The increase in moisture content is mainly because of the ingress of water from atmosphere during storage.

3. **Effect of storage condition on ash content (in percent) of dried fermented soybean (hawaijar) during storage.**

The ash content (%) of soybean increased slightly during the fermentation process as it could be due to breakdown of complex substances into smaller molecules that is why some minerals became free during that process. But after drying it remained almost constant and its content reduces negligibly as the storage period increases. The effect of storage period and different drying methods on ash content (%) of fermented soybean products packed in HDPE is presented in fig 2. On the critical evaluation of the result, it was found that the ash content of ash content varied very little during the storage period because the ash content only gives an idea about non-volatile material present in food and undergoes very minimum change and does not disintegrate during storage period. The results were dissimilar to the results obtained by **Premarani and Chhetry (2011)** . This may be because of the effect of sun drying which is more effective for loss of ash content than tray drying as observed from table 1 which suggests the effect of sun drying is more prominent as far as the loss of ash content is concerned. Also the loss of ash content is more as observed during storage in the samples T3 and T4 which were sun dried.

4. **Effect of storage condition on protein content (in percent) of dried fermented soybean (hawaijar) during storage.**

The protein content (%) of soybean reduces during fermentation due to higher activity of enzymes. The amount of free amino acids increased suddenly during fermentation and even slightly increased during drying. The rapid increase in free amino acids in the early stages of fermentation is an indication of rapid protein hydrolysis. Proteolysis plays an important role during the ripening of hawaijar as in the case of other fermented soybean foods (**Han *et al*.,2002).** The protein retention properties of tray dried product were better than solar dried product because the protein content reduces considerably due to photochemical reactions during sun drying of the product. The effect of storage period condition and different drying methods on protein content of the hawaijar packed in HDPE is presented in Fig 3. On the critical evaluation of the result, it was found that the protein content of hawaijar packed in HDPE decreased with increase in storage period. Overall results revealed that the protein content decreases during storage period and this is due to the increase in water activity which results in activation of certain enzyme. and due to the respiration of food which occurs after the product has been made.

5. **Effect of storage condition on crude fibre content (in percent) of dried fermented soybean (hawaijar) during storage.**

Crude fibre content (%) of raw soybean was 3.8%,lowest in boiled unfermented beans(2.5%),highest in three days fermented hawaijar(8.2%) and then decreased during the storage period. On comparison of the data obtained by **Premarani and Chhetry (2011)** the data were found in close similarity as there was considerable loss observed during the storage period of fermented soybeans. On critical evaluation it was found that the sample T3 was found having maximum loss which may be because it was sun dried and stored at ambient conditions. Minimum loss was observed in T2 as it was tray dried and stored at refrigeration condition. This may be because of the activity of lipase enzyme which is affected in case of refrigeration and during ambient conditions it rather gets more active leading to more loss of fibrous content during storage.

6. Effect of storage condition on yeast and mold count (cfu/g) of dried fermented soybean (hawaijar) during storage.

Yeast and mold count (cfu/g) of dried fermented soybean (hawaijar) was nil after drying but it increased during the time of storage. The minimum count was found to be nil in dried zero day sample and maximum count was observed in T1 after 120 days which was equal to 7.8×10^2 cfu/g. On comparison of the results obtained during this present study with that of (**Gernah *et al.*,2012)** it was found dissimilar as the soybean does not has so much much of rich carbohydrate to support yeast and mod growth due to which very less number of colonies were observed. Also through table 1 it was found that maximum number of colonies were observed in T1 and T3 which were stored in ambient conditions while T2 and T4 had the least growth having been stored at refrigeration conditions. It was thus concluded that the refrigeration has a detrimental effect on the growth of number of colonies of yeast and mold count which can be an active method of storage.

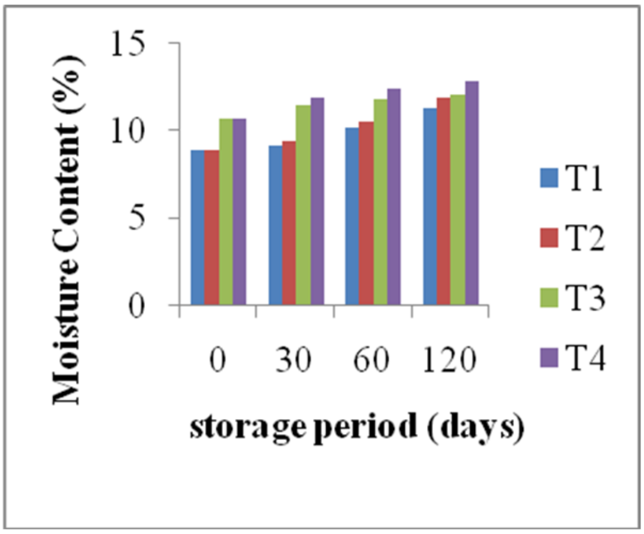

Figure 1. Effect of storage condition on moisture content (%) of dried fermented soybean (hawaijar) during storage.

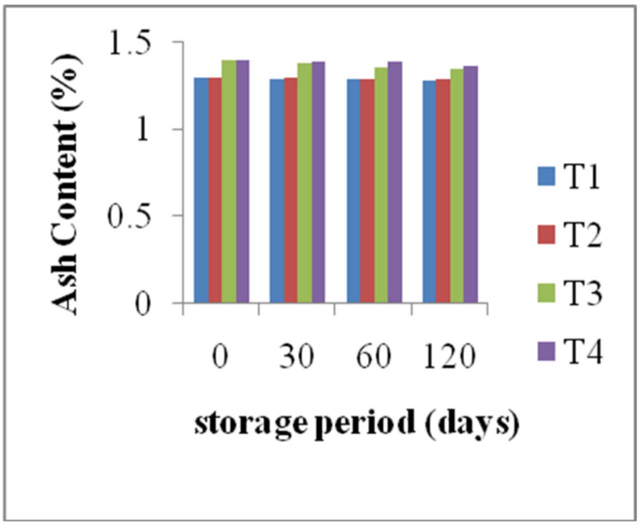

Figure 2. Effect of storage condition on ash content (%) of dried fermented soybean (hawaijar) during storage.

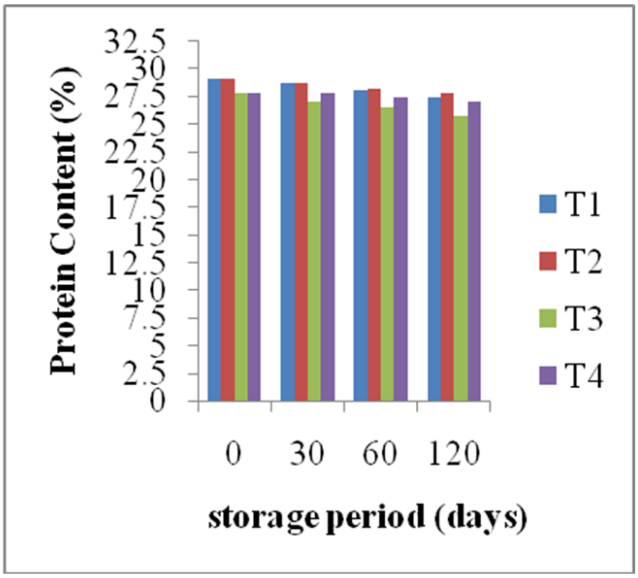

Figure 3. Effect of storage condition on protein content (%) of dried fermented soybean (hawaijar) during storage.

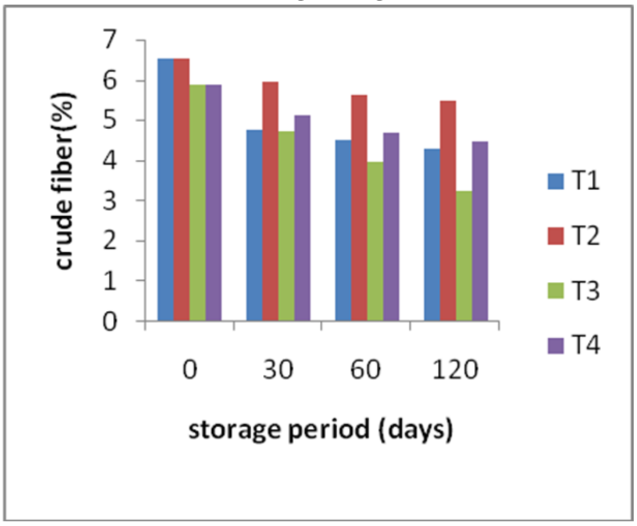

Figure 4. Effect of storage condition on crude fibre content (%) of dried fermented soybean (hawaijar) during storage.

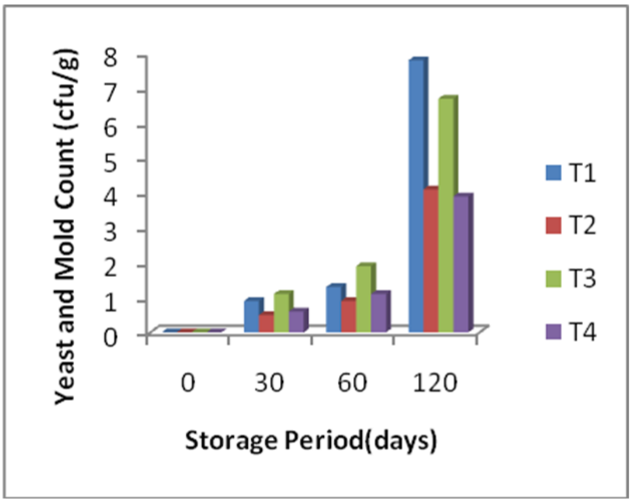

Figure 5. Effect of storage condition on yeast and mold count (cfu/g) of dried fermented soybean (hawaijar) during storage.

IV. CONCLUSION

The present project was on Effect of storage period on Quality characteristics of tray and solar dried fermented soy product "Hawaijar". The critical evaluation of nutritional characteristics revealed that tray drying is better drying method as compared to sun drying as far as retention of nutritional attributes is concerned. There is very slight difference in the nutritional value of dried fermented soybean product (hawaijar) stored in ambient temperature and refrigerated temperature. So it can be concluded that there is no need to store the product in refrigerated environment as the product stored at ambient temperature is acceptable even after four months. Thus storage of product at refrigerated temperature would cause undue loss of energy and resources, which can in turn be used for other useful purposes.

V. ACKNOWLEDGEMENTS

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VI. REFERENCES

[1] **A.O.A.C (1990).** *Official Methods of analysis.*Association of Official Analytical Chemists. 15th edition. Virginia.

[2] **AOAC (1995)** Official methods of analysis (16th ed.) (pp. 27–29). Washington, DC: Association of Official Analytical Chemists. benefit and management strategies. The Journal of the American Bamboo Society 17 (1): 4-20.

[3] **Blandinob, A., Al-Aseeria,M.E., Pandiellaa, S. S., Canterob,D.,Webba,C (2003)**. Cereal-based fermented foods and beverages. Food Research International 36 (2003) 527–543.

[4] **Gernah,D.I., Ariahu,C.C., and Umeh,E.U. (2012).** Physical and Microbiological Evaluation of Food Formulations From Malted and Fermented Maize (*Zea mays* L.) Fortified with Defatted Sesame (*Sesamun indicum* L.) Flour. Advance Journal of Food Science and Technology 4(3): 148-154, 2012ISSN: 2042-4876.

[5] **Han, B. Z., Wang, I.H., Rombouts, F. M. and Nout, M.I.R (2002**). Effect ofNaCl on textural changes and protein and lipid degradation during the ripening stage of *sufu*, a Chinese fermented soybean food. *J. Sci. Food Agric.*83: 899- 904.

[6] **Premarani, T. and Chhetry, G. K. N (2010)**. Evaluation of Traditional Fermentation Technology for the Preparation of Hawaijar in Manipur. Assam University Journal of Science & Technology: Biological and Environmental Sciences 6 (I): 82-88.