INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560–8530/2003/05–4–523–525
http://www.ijab.org

Preparation and Evaluation of Texturized Vegetable Meat from Legumes

AYAZ KHURRAM, SALIM-UR-REHMAN, UMAIR ARSHAD BAJWA, BABAR EHSAN BAJWA AND KASHIF JABBAR
Institute of Food Science Technology, University of Agriculture, Faisalabad–38040, Pakistan

ABSTRACT

Texturized Vegetable Protein (TVP) of three legumes *viz*. soybean (*Glycin max*), gram (*Phaseolus mungo*) and matri (*Lathyrus Sativus*) was extracted to simulate vegetable meat in comparison with minced beef after forming the meatballs. The purpose of this study is to check the effect of storage on physicochemical and sensory properties of Texturized Vegetable Meat (TVM) that can be served as meat analogs. Adjusting the pH of the solution, precipitation, coagulation and filtration isolated the legume proteins. Extracted legume protein isolates were incorporated with fat and then extruded to get meat like chewness and flavor. Meatballs were prepared from this Texturized Vegetable Protein (TVP). One month storage behavior of these meatballs regarding physico-chemical analysis such as juiciness, shrinkage and pH showed decreasing trend. This sensory evaluation of meatballs for color, flavor, taste, texture and overall acceptability indicated that all the textured legume meatballs were acceptable by the judges.

Key Words: TVP; Meat; Sensory evaluation

INTRODUCTION

Textured vegetable protein (TVP) are generally, those fabricated vegetable products that can be used to replace meat completely in a food serving and those textured vegetable protein entities that can be eaten in combination with meat as extenders. These textured plant protein resemble meat in chewness and flavor (Bennion, 1980; Siddique, 2000). Animal protein, particularly meat is expensive and on worldwide basis in short, short supply (Birch *et al.*, 1986). Hence, there is a need to make the change from one type of protein to another. The transition from animal protein to plant protein can be possible in a gradual, smooth and orderly fashion by utilizing high protein mixture, isolated protein and concentrated proteins from plant sources. Although most vegetable proteins are of inferior quality to animal protein but legumes are good source of protein (Siddique, 2000). Due to health risk of red meat, vegetable protein is more beneficial to those affected from coronary heart diseases. Legumes have high amount of protein i.e. 25-50%. Pulses are low cost leguminous crop cultivated in Pakistan. In 2000, the total production of all these pulses was 802400 tons (Anonymous, 2000). Beans were washed and soaked in water at 30°C for three hours, so as to soften the husk and to remove a majority of anti nutritional factors present in legumes. The soaked beans were washed with water until the husk was completely removed and then dried in a cabinet drier at 70°C for 5-8 h (Riaz, 1999).

MATERIALS AND METHODS

Three types of legumes were procured from local market while the beef was purchased from local butcher's shop. Beans were washed and soaked in water at 30°C for three hours, so as to soften the husk and to remove a majority of anti nutritional factors present in legumes. The soaked beans were washed with water until the husk was completely removed and then dried in a cabinet drier at 70°C for 5-8 h. Then beans were ground in an electrical grinder, so as to pass through the 80-mesh sieve. The flours obtained were packed in the polythene bags separately and sealed. The packed legume flours were stored. This study was carried out at Institute of Food Science & Technology, University of Agriculture, Faisalabad. Lean meat was prepared after trimming off fat, connective tissues and bones. Meat was cut into smaller pieces of equal sizes. 10% vegetable oil added in to meat and minced thrice in a steel mincer in order to get homogeneous minced meat (Farooq *et al.*, 1997).

Preparation of vegetable meat from legumes. For the preparation of meat analogs, the protein was isolated in an alkaline medium (8.5-10 pH), precipitated at acidic pH (2.5-4) and filtration (Smith & Circle, 1980). These protein isolates were extruded to form vegetable meatballs. The meatballs were prepared from minced beef and extruded legumes protein isolates (Anonymous, 1997). These meatballs were prepared by making round balls and then pressed to give flat circular shape of 3 inches diameter.

Treatments: T_0 = meatballs containing 100% minced beef; T_1 = meatballs containing 100% texturized Soy protein; T_2 = meatballs containing 100% texturized gram protein; T_3 = meatballs containing 100% texturized matri protein

Storage. After preparation, meatballs were packed in polythene bag and marked separately. Sealed and stored in a deep freezer at –20°C for 30 days for subsequent studies at an interval of 15 days (Campbell *et al.*, 2002) and marked separately.

Frying. The prepared, packed and stored vegetable meat balls were deep fat fried in refined vegetable oil at 135°C for 4 min as described by Sharma (1999) at an interval of 15 days and then subjected to further analysis.

Evaluation. The physico-chemical analysis such as juiciness, shrinkage and pH were carried out for one month at 15 days interval. Similarly, the sensory evaluation of the product for color, flavor, taste, texture and overall acceptability was conducted using the Hedonic scale rating of 1-9 (Sharma, 1999). This evaluation was carried out at Institute of Food Science & Technology, University of Agriculture, Faisalabad. The data obtained was analyzed statistically using two factorial design (Steel *et al.*, 1996)

RESULTS AND DISCUSSION

The results obtained during storage regarding the different texturized vegetable proteins are discussed as under:

Physico-Chemical Analysis. The results of physico-chemical analysis of meatballs containing beef and different texturized vegetable proteins (TVP) are given in Table I. These show a gradual storage behavior in all the treatments.

Table I. Mean values (%) of treatments for physicochemical analysis of texturized vegetable meat from legumes

Treatments	Juiciness	Shrinkage	pH
T_0	13.14a	10.02a	3.16d
T_1	9.80c	3.05c	4.66c
T_2	9.81c	2.16d	4.92a
T_3	11.44b	3.16b	4.81b

T_0 = meatballs containing 100% minced beef; T_1 = meatballs containing 100% texturized Soy protein; T_2 = meatballs containing 100% texturized gram protein; T_3 = meatballs containing 100% texturized matri protein.

Highest score for juiciness was observed in control followed by Matri textured protein; gram textured protein and soy-textured protein. These results are in line with the findings of Siddique (2000). The highest pH value was found to be 4.92 and the lowest being 3.16 for different treatments, so they lie within the acceptable range as given by Farooq *et al.* (1997).

Table II. Mean values (%) of storage for physicochemical analysis of texturized vegetable meat from legumes

Storage periods	Juiciness	Shrinkage	pH
0-days	11.45a	5.29a	4.45a
15-days	11.05b	4.56b	4.38b
30-days	11.64c	3.95c	4.33c

The highest score for juiciness was observed at 0 day storage and the lowest score at 30 days of storage. Decrease in the score happened due to moisture evaporation and fat-oxidation during storage (Javed, 2000). The Shrinkage value was highest at 0 day storage period followed by 15 days of storage period but there was also a change in the ash content at 30 days of storage period. Mean values for storage period ranged from 4.45 to 4.33 showing a decrease from 0 day to 30 days of storage. The change in pH was due to chemical and enzymatic changes, which might have affected the functional and cationic groups of the different ingredients of the meatballs during storage as, explained by Javed (2000).

Sensory evaluation. The average scores regarding color, flavor, taste, texture and overall acceptability of the meatballs with their levels of means are given in Table III.

Table III. Mean values (%) of treatments for sensory characteristics of Texturized Vegetable Meat from legumes

Treatments	T_0	T_1	T_2	T_3
Color	6.17b	6.30b	6.73a	6.53ab
Flavor	6.82a	6.19b	6.26b	6.28b
Taste	6.62a	6.60a	6.07b	6.11b
Texture	6.48	6.15	6.44	6.31
Overall	7.24a	6.45b	6.88a	6.82ab

T_0 = meatballs containing 100% minced beef; T_1 = meatballs containing 100% texturized Soy protein; T_2 = meatballs containing 100% texturized gram protein; T_3 = meatballs containing 100% texturized matri protein.

The color values for control are much less than matri. The fading of beef balls'colour is due to fat oxidation. The frozen meatballs contain salt. Salt enhance the flavor but acts as a pro-oxidant and initiates the oxidative deterioration of fat. Present results on this aspect of study are in agreement with Taylor and Walsh (2002) and Truong and Walter (1995). Meatballs with minced beef had superior taste among treatments. Control obtained the highest score for texture. The over all acceptability also decreased due to different treatments. Gujral *et al.* (2002) also found a decrease in over all acceptability.

Table IV. Mean values (%) of storage for Physicochemical analysis of Texturized Vegetable Meat from different legumes

Storage periods	0 days	15 days	30 days
Color	6.92a	6.30b	6.06b
Flavor	6.55	6.40	6.20
Taste	6.69a	6.34ab	6.02b
Texture	6.78a	6.28b	5.98b
Overall	7.24a	6.80b	6.50b

Color was not affected up to couple of days of storage but affected significantly after five days of storage period. After about 15 days storage, the color of the meatballs became dull in all the samples. The fading started from the surface and proceeded towards the center of the meatballs. There are a number of factors, which are known to affect the color of meat (Truong & Walter, 1995). Taste of all the samples was found to decrease during storage. The

maximum value was at 0 day followed by score at 15 days and at 30 days of storage. Decrease in the taste scores during storage took place might be due to the oxidation of fat and interaction of other chemical constituents. The highest quality score for texture was obtained after a storage period of 0 days followed by 15 days and 30 days. Meatballs having beef had the highest score and the lowest score for texture was attained by gram textured protein. During storage, water evaporated and thus the texture of the meatballs was disturbed. Water gives a good texture to the meatballs (Taylor & Walsh, 2002.). Addition of extra fat also adversely affects the texture during frying (Farooq *et al.*, 1997). The Over all acceptability were highest at 0 day storage period followed by 15 days of storage period but there was a change in the Over all acceptability at 30 days of storage period.

CONCLUSION

During storage, the physicochemical and sensory properties are important parameters to evaluate the qualities of any food product. The ultimate purpose for producing a food item is to reach the consumer. The consumer depends on mainly two characteristics; sensory evaluation and shelf life. All the textured legume meatballs were acceptable by judges.

REFERENCES

Anonymous, 1997. *Best Ever Recipes.* 14th Ed. p. 20. Times Printers Private Ltd. Singapore

Anonymous, 1999. Soy Protein Concentrate retain high levels of isoflavones. *Food Technol.,* 53: 14

Anonymous, 1999-2000. *Agri. Statistics of Pakistan.* Government of Pakistan. Ministry of Food, Agriculture and Livestock. Food Agriculture and Livestock division. (Economic Wing) Islamabad-Pakistan

Bennion, M., 1980. *The Science of Food.* John Wiley and Sons, New York, USA

Birch, G.G., A. Cameron and M. Spencer, 1986. *Food Science*. Pergamon Press, Oxford, UK

Campbell, B., B. Clapton and C. Tipton, 2002. The classification and selection of material and components. *Food Technol*., 21–7

Farooq, Z., N. Huma, S. Rehman and M. Asghar, 1997. Effect of tallow on quality of fresh beef sausages during storage. *Pakistan J. Food Sci.,* 7: 79–82

Gujral, H.S., A. Kaur, N. Singh and N.S. Sodhi, 2002. Effect of liquid whole egg, fat and textured soy protein on the textural and cooking properties of raw and baked patties from goat meat. *J. Food Engg*., 53: 377–85

Javed, Z., 2000. Incorporation of Legumes as Nonmeat Protein Extenders in Fresh Beef Sausages. *M.Sc. Thesis*, Dept. Food Tech., Univ. Agric. Faisalabad, Pakistan

Riaz, M.N., 1999. Healthy baking with soy ingredients. *Cereal Foods World*, 44: 136–9

Sharma, B.B., 1999. *Meat and Meat Products Technology*. Jaypee Brothers' Medical Publishers Pvt. Ltd. N. Delhi, India

Siddique, U., 2000. The Substitution of Textured Soy-protein with Red Meat in Pizza Topping. *M.Sc. Thesis*, Dept. Food Tech., Univ. Agric. Faisalabad, Pakistan

Smith, A.K. and S.J. Circle, 1980. *Soybeans: Chemistry and Technology (Revised)*. The AVI Pub. Co., Inc. Westport, Connecticut, USA

Steel, R., J.H. Torrie and D. Dickey, 1996. *Principles and Procedures of Statistics*. *A Biometrical Approach.* 3rd Ed. McGraw Hill Book Co. Inc., New York, USA

Taylor, B.L. and M.K. Walsh, 2002. Development and sensory analysis of a textured whey protein meatless patty. *J. Food Sci.,* 67: 1555–8

Truong, V.D. and W.M. Walter, 1995. Physical and sensory properties of sweet potatoes puree texturized with cellulose derivatives. *J. Food Sci.,* 59: 1175–80

(Received 09 August 2003; Accepted 15 September 2003)