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Studies on Development, Sensory Evaluation and Nutritional Composition of Quinoa Bar

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ABSTRACT: In the present investigation, the quinoa bar was prepared by using different proportion of quinoa and defatted soy flour. In previous studies, various types of quinoa bar was prepared using puffed quinoa and quinoa flour. The quinoa and soybean contain anti-nutritional factor which gives bitter and beany flavor to bar which lowers acceptability of bar. Therefore to overcome these problems quinoa and soybean were treated with chemicals like sodium bicarbonate (2%) and citric acid (1%) solution. The soaked quinoa and soybean seeds were dried, roasted to reduce traces of anti-nutritional factor and to improve taste and flavor of quinoa bar. The different formulations were made with variation in defatted soy flour level from 0, 10, 20, 30 and 40% for T_0, T_1, T_2, T_3 and T_4 respectively. The prepared quinoa bar was evaluated for their sensory characteristics and nutritional composition. The result revealed that quinoa bar with 20% defatted soy flour (T_2) secured highest score (8.3) as compared to other bar samples. The prepared quinoa bar (T_2) had 18.1% moisture, 14.5% protein, 2.14% fat, 62.1% carbohydrate, 1.5% ash and 2.2% crude fiber. The prepared quinoa bar (T_2) provide 325.6 kcal/100g energy. It was found that quinoa bar prepared with addition of defatted soy flour was good source of protein ash and crude fibre. Thus, defatted soy flour can be successfully utilized as a functional ingredient for preparation of quinoa bar with good nutritional value.

Keywords: Ready-to-eat, snack food, quinoa bar, sensory evaluation, nutritional composition.

INTRODUCTION

Recently, the production and consumption of Ready-to-Eat foods have increased significantly due to changes in life style. Because of the increasing consumer demand for healthy, natural and convenient foods attempts are being made to improve nutritional values of snack foods by modifying their nutritive composition (Kotagi, 2011). Food industries developed food products like nutrition bars due to busy life styles and increasing demands of consumers for quick sources of good nutrition and convenience (Izzo and Niness, 2001). Cereal bars are made up of multiple ingredients including cereals, legumes, millets, nuts, sugar, vegetable oil and syrups (Lobato *et al.*, 2011). Now a days diet based on whole grains are increasing due to various health benefits of cereals as they are good source of dietary fiber, antioxidant and vitamins. But the protein quality of cereals are not good as they are deficient in lysine. However, the inclusion of legumes in the diet improves the protein quality of cereals as legumes are rich in lysine and also the cereal protein complement legume protein as it is rich in methionine (Padmashree *et al.*, 2012).

Quinoa is the plant belongs to the *Chenopodiaceae* family, having genus *Chenopodium*. It is an ancient grain of South America, which is called as a super food having great demand these days for its outstanding nutritional and health value (Bhathal *et al.*, 2015; James, 2009). Quinoa is known to be a pseudocereal of high nutritional importance and its protein quality is outstanding, having all essential amino acids which are deficient in cereals. Quinoa is known to be a gluten-free grain because it contains very little or no prolamin (James, 2009), which is another differential factor o quinoa, hence consumed by celiac disease patients and used in production of several foods targeted to this population group (Jacobsen, 2003; Stikic, 2012). Quinoa contain vitamin C, E, B complex, minerals such calcium, potassium, iron, magnesium, manganese and phosphorus, good quality isoflavones (linoleic and linolenic) and lipids, which give quinoa considerable antioxidant properties (Miranda, 2012). Quinoa contain protein in the range from 13.8% to 16.5% (Vega-Gálvez *et al.*, 2010). The amino acid composition of

quinoa is similar to rice with higher content in lysine (4.8 g/100 g) and threonine (3.7 g/100 g) protein, which is the limiting amino acids in conventional cereals like wheat and maize (Dini *et al.,* 2004). Due to presence of superior quality protein in quinoa it is a suitable food for addressing globally prevailing protein energy malnutrition (Jancurová *et al.,* 2009).

Soybean is belongs to the *Leguminosae* family having botanical name *Glycine max* (L.) Merrill (Gazzoni, 1994). It is native of China and used as important source of dietary protein and oil throughout the world (Liu, 1997). Soybean contain 43.2% of good quality protein, minimal saturated fat, about 21% carbohydrates (Gopalan *et al.*, 1999). The amino acid profile of soy protein is good as compare to other plant proteins. The dietary protein of soybean directly helps in lowering serum cholesterol levels (Mirrahimi *et al.,* 2010). The soy isoflavone (genistein and diadzein) has estrogenic activity and used for prevention and treatment of hormone dependent cancers (Adlercreutz, 2002). Soy oil contain plan sterol which has cholesterol-lowering activity (Law, 2000).

Date is the major staple food in the United Arab Emirates (Oladipupo, 2019). The date contain carbohydrate (70–80%) in the form of glucose and fructose which are readily absorbed during the digestion and causes rapid elevation of blood sugar (Liu *et al.,* 2000). Dates are good source of energy mainly due to presence of high amount of readily digestible carbohydrates (Vayalil, 2002). In addition to their high natural sugar content, dates also contain additional nutritive components in the form of proteins, crude fiber, fats and antioxidants which making dates a functional food with significant health benefits (Arshad *et al.,* 2019). Date is good source of vitamins and minerals like phosphorus, iron, potassium and a significant amount of calcium (Shaheen *et al.,* 2013). Dates are high in potassium and low in sodium, which are beneficial for people suffering from hypertension (Vayalil, 2012). Date also contain a special type of fiber known as β-D-glucan which has high anticancer activity (Elleuch *et al.,* 2011).

Keeping in view the overall health benefits of quinoa, soybean, date and the demand from consumer, the objective of this study was to develop a quinoa bar utilizing soybean in the formulation along with pseudocereal quinoa to deliver a nutritious health product. Sensory evaluation and nutritional composition of the quinoa bar samples were determined to evaluate the acceptability of the product.

MATERIALS AND METHODS

A. Materials

The raw material like quinoa seeds was procured from Mamta agro (Gujarat), India and soybean, date and glucose syrup were procured from local market of Parbhani. The grains were cleaned to separate all foreign matter, dust dirt, straw, broken and immature grains.

Chemicals and glasswares. The chemicals is of analytical grade and glassware required for present investigation will be obtained from laboratory, Department of Food Business Management, College of Food Technology, VNMKV, Parbhani.

Pre-treatment and processing of raw materials. The quinoa and soybean seeds were cleaned and soaked in 2% sodium bicarbonate and 1% citric acid solution to reduce anti-nutritional factors. The soaked seeds were drained, washed with running tap water and allow to dry. Dates were pitted and after pitting steam was given to dates for 20-25 min until they become soft.

B. Methods

Preparation of quinoa flour and defatted soy flour. The selected quinoa and soybean seeds were cleaned to remove the unwanted material such as dust, dirt, stone, mud particles, leaf and soaked in 2% sodium bicarbonate and 1% citric acid solution (6 hours for quinoa and 12 hours for soybean) to remove anti-nutritional factors. The soaked grains were drained, washed with running tap water and allow to dry. After drying quinoa was roasted at 140ºC for 7 min and milled into fine flour. Soybean was milled into fine flour and defatted with soxhlet extractor using petroleum ether at 60°C. The obtained flour was roasted to improve the taste and sensory characteristics of bar.

Sensory evaluation. The sensory evaluation of quinoa bar was carried out by a 10 semi trained panel member based on 9 point hedonic scale and the score were given by evaluating the sensory attributes for quinoa bar such as appearance, color, flavor, taste, texture and overall acceptability which was compared with control sample.

Proximate composition. The prepared quinoa bar samples were analyzed for moisture, protein, fat, carbohydrate, ash and crude fiber contents according to standard methods given by (AOAC, 2005).

Preparation of quinoa bar. Preparation of quinoa bar carried out according to the formulation given in Table 1. The ingredient used in quinoa bar preparation includes roasted quinoa and defatted soy flour, pitted date and glucose syrup with different level of incorporation of quinoa to defatted soy flour viz., 90:10, 80:20, 70:30 and 60:40. The inclusion of defatted soy flour in the ingredient list enhanced the nutritional and sensory characteristics of the final product. The pitted soft date and dry ingredients were added and mixed in mixer grinder until a homogeneous consistency will reach. The obtained mixture was then transferred to a flat pan greased with butter, hand pressed and molded. Then cut into equal size rectangular bars. The baking was done by placing pan in the oven at 120°C for 5 minutes and after baking pan was left for cooling. The bars were removed from the pan and then packed in high density polyethylene as shown in Fig. 1.

Table 1: Formulation of quinoa bar by using different level of defatted soy flour.

Ingredients	T_0	T_1	T_2	T_3	T_4
Quinoa flour(g)	100	90	80	70	60
Defatted Soy flour(g)	-	10	20	30	40
Date(g)	100	100	100	100	100
Glucose syrup(ml)	10	10	10	10	10

T_0 (Control) –Without addition of DSF; **T_1** – With addition of 10% DSF; **T_2** – With addition of 20% DSF; **T_3** – With addition of 30% DSF; **T_4** – With addition of 40% DSF.

Standardization of recipe for quinoa bar. The recipe of quinoa bar was standardized on the basis of sensory evaluation by varying the proportion of quinoa to defatted soy flour by keeping date and glucose syrup constant. The standard recipe for quinoa bar presented in Table 2.

Table 2: Standardized recipe for quinoa bar.

Sr. No.	Ingredients	Quantity
1.	Quinoa flour(g)	40
2.	Defatted soy flour(g)	10
3.	Date (g)	50
4.	Glucose syrup(ml)	5ml

Flow sheet for preparation of quinoa bar

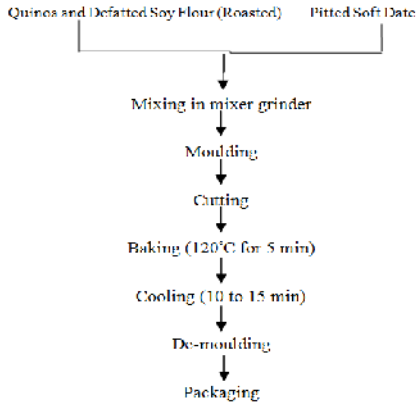


Fig. 1. Flowsheet for preparation of quinoa bar.

RESULT AND DISCUSSION

A. Sensory evaluation

Sensory evaluation of quinoa bar was done with respect to the parameters like appearance, color, flavor, taste, texture and overall acceptability and the obtained data of average sensory score is presented in Table 3. The sensory score of color clearly indicated that quinoa bar T_2 obtained highest score for color (8.3) and T_0 obtained good score (7.7). The quinoa bar sample T_2 highest score for flavor (8.3) while T_4 obtained lowest score (7.2) for flavor. The sample T_2 obtained maximum score for taste (8.1) while quinoa bar sample T_4 obtained minimum score (7.0) for taste. Texture is the characteristics of touch and mouth feel. The result from Table 3 showed that the texture of quinoa bar T_2 secured maximum score (8.2) and lowest score found in T_4 (6.8). The quinoa bar sample T_2 obtained highest score due to significant addition of 20% defatted soy flour with overall acceptability score 8.3 and T_4 obtained lower overall acceptability score (7.2).

The highly acceptable and desirable product with respect to color, appearance, flavor, taste, texture and overall acceptability can be obtained with combination (T_2) of 80% quinoa flour and 20% defatted soy flour. The higher level of defatted soy flour was found undesirable for all the parameters such as color, appearance, taste, texture, flavor and overall acceptability on of gives floury and beany taste in mouth. The average result of sensory score is presented by spider plot graphical representation (Fig. 2).

Table 3: Sensory evaluation of quinoa bar.

Samples	Appearance	Colour	Flavour	Taste	Texture	Overall Acceptability
T_0	7.5	7.7	7.3	7.2	7.2	7.4
T_1	7.1	7.3	7.2	7.1	7.3	7.2
T_2	8.4	8.3	8.3	8.1	8.2	8.3
T_3	8.0	8.1	8.0	7.8	7.8	7.9
T_4	7.2	7.6	7.2	7.0	6.8	7.2
SE±	0.05077	0.03528	0.05427	0.05333	0.06037	0.04146
CD at 5%	0.14892	0.10347	0.16125	0.15643	0.17707	0.12159

*Each value is an average of three determinations

B. Nutritional composition of quinoa bar

The data pertaining to various nutritional composition such as moisture, protein, fat, total carbohydrate, ash and crude fiber of selected quinoa bar (T_2) was determined and result obtained are tabulated in Table 4.

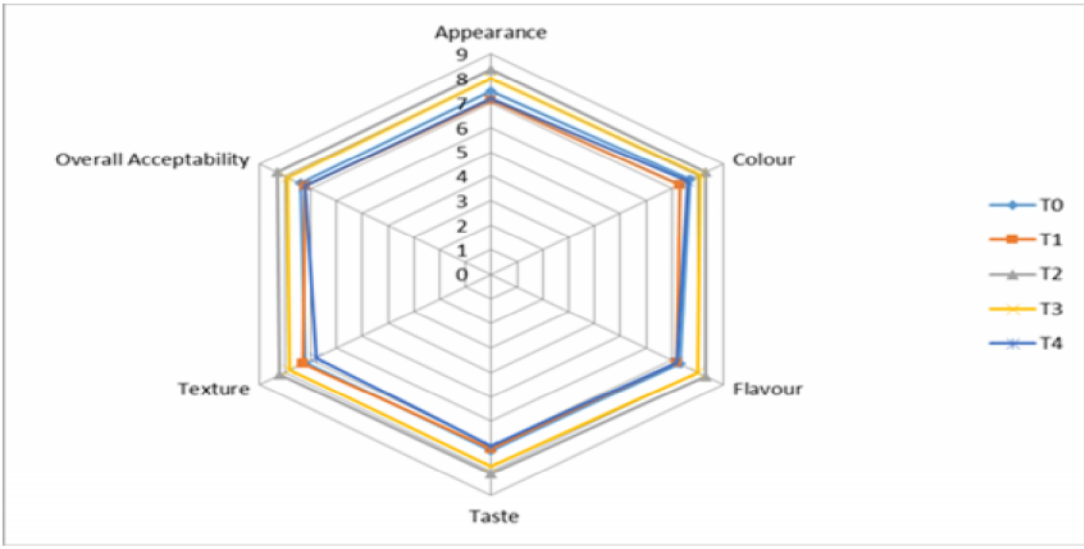


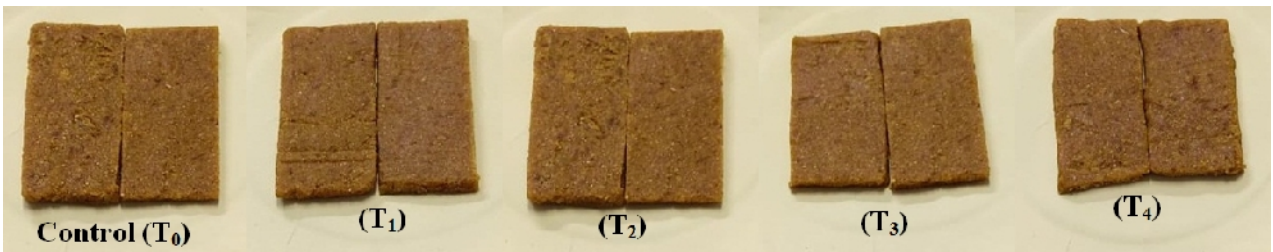
Fig. 2. Graphical Representation of Average Sensory Score.

Table 4: Nutritional composition of quinoa bar.

Chemical parameter	Values (g/100g)	
	T_0 (Control)	T_2
Moisture	17.6±0.2	18.1±0.2
Total protein	7.9±0.25	14.5±0.1
Fat	2.05±0.05	2.14±0.15
Total carbohydrates	67.8±0.32	62.1±0.43
Ash	1.3±0.2	1.5±0.15
Crude fibre	2.1±0.1	2.2±0.1
Energy value(kcal/100g)	321.2±5.0	325.6±2.4

*Each value is an average of three determinations

The data presented in Table 4 showed the chemical composition of control bar and quinoa bar (T_2). The result revealed that moisture, protein, fat, carbohydrate, ash and crude fibre content of control bar sample (T_0) was 17.6%, 7.9%, 2.05%, 67.8%, 1.3% and 2.1% respectively. The control quinoa bar provide 321.2 kcal/100g of energy. Whereas quinoa bar (T_2) sample had moisture content of 18.1%. The protein content was 14.5%. The increase in protein content of quinoa bar (T_2) is due to high protein content (50%) of defatted soy flour. The total carbohydrate content of quinoa bar (T_2) was 62.1%. The decrease in carbohydrate content of quinoa bar (T_2) due to lower carbohydrate content of defatted soy flour (30%). The fat content of quinoa bar (T_2) was 2.14%. The ash and crude fiber content of quinoa bar (T_2) was 1.5% and 2.2% respectively. The prepared quinoa bar provide 325.6 kcal/100g of energy. The obtained results pertaining to chemical composition were closely related with the result reported by Yadav and Bhatnagar (2016). Yadav and Bhatnagar (2016) reported physicochemical composition of cereal bar prepared by incorporation of defatted soy flour. The result showed that the prepared cereal bar prepared with 20% defatted soy flour had 0.13 % moisture, 19.61% protein, 68.17% carbohydrates, 9.91% fat, 1.63% ash and 0.89% crude fibre.



CONCLUSION

The study demonstrated that the quinoa and soybean can be used to formulate quinoa bars of good sensory and nutritional value which provide good amount of carbohydrate, protein, fat, dietary fiber and minerals. The quinoa bar prepared with 20% defatted soy flour was found to be highly acceptable and recorded maximum score in all the sensory attributes. The prepared quinoa bar (T_2) had 18.1% moisture, 14.5% protein, 2.14% fat, 62.1% carbohydrate, 1.5% ash and 2.2% crude fiber. The prepared quinoa bar (T_2) provide 325.6 kcal/100g energy. It can be concluded from result that good nutritional quality quinoa bar can be prepared by using quinoa and defatted soy flour, as soybean is rich in protein and well utilized as functional ingredient for preparation of quinoa bar.

FUTURE SCOPE

Increasing consumer preference towards snack bar and energy nutrition bars in place of breakfast cereals due to hectic schedules and rising health awareness is expected to provide impetus for growth of cereal bar market. As the quinoa and soybean is rich in protein content and utilization of these protein rich sources we can increase the nutritional value of cereal bar which helps to reduce protein malnutrition problems in developing countries.

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Conflict of interest: The authors declare that there is no conflict of interest in this paper.

REFERENCES

Adlercreutz, H. (2002). Phyto-oestrogens and cancer. *Lancet Oncology*, *3*: 364-373.

AOAC, (2005). Official Aethods of Analysis of the AOAC International, 18th ed. Association of Official analytical chemists, Gaithersburg, MD.

Arshad, M.S., Batool, S.M., Khan, M.K., Imran, M., Ahmad, M.H., Anjum, F.M. and Hussain, S. (2019). Bioevaluation of functional date bars using rats as model organism against hypercholesterolemia. *Lipids in Health and Disease*, *18*(1): 148.

Bhathal, S., Grover, K. and Gill, N. (2015). Quinoa- A treasure trove of nutrients. *Journal of Nutrition Research*, *3*(1): 45-49.

Dini, I., Tenore, G.C. and Dini, A. (2004). Phenolic constituents of Kancolla seeds. *Food Chemistry, 84*: 163-8.

Elleuch, M., Bedigian, D., Roiseux, O., Besbes, S., Blecker, C. and Attia, H. (2011). Dietary fiber and fiber-rich by-products of food processing: characterization, technological functionality and commercial applications: A review. *Food Chemistry*, *124*(2): 411–421.

Gazzoni, D.L. (1994). Botany in: tropical soybean: improvement and production. *Food and Agricultural Organization of the United Nations*, Rome, 1–12.

Gopalan, C., Shastri, R. and Balasubramaniam, S.C. (1999). Nutritive value of Indian foods, national institute of nutrition, Indian council of medical research, Hyderabad, India (reprinted), 1-156.

Izzo, M. and Niness, K. (2001). Formulating nutrition bars with inulin and oligofructose. *Cereal Foods World*, *46*: 102-106.

Jacobsen, S.E. (2003). The worldwide potential for quinoa (*Chenopodium quinoa* Willd.). *Food Review International*, *19*: 167-177.

James, L.E.A. (2009). Quinoa (*Chenopodium quinoa* Willd.): composition, chemistry, nutritional, and functional properties. *Advances in Food and Nutrition Research*, *58*(1): 1-31.

Jancurová, M., Minarovičová, L. and Dandar, A. (2009). Quinoa – a review. *Czech Journal of Food Sciences*, *27*(2): 71-79.

Kotagi, S.K. (2011). Little millet (*Panicum miliare*) flakes: development, value addition, quality evaluation, consumer acceptability and commercialization. Ph.D. Thesis, Department of Food Science and Nutrition, University of Agriculture Sciences, Dharwad.

Law, M.P. (2000). Plant sterol and stanol margarines and health. *British Medical Journal*, *320*: 861-864.

Liu, K. (1997). Chemistry and nutritional value of soybean components. *Chemistry Technology Utilization*, *10*: 25-113.

Liu, S., Willett, W.C., Stampfer, M.J., Hu, F.B., Franz, M., Sampson, L., Hennekens, C.H. and Manson, J.A.A. (2000). Prospective study of dietary glycemic load, carbohydrate intake and risk of coronary heart diseases in U.S women. *American Journal Clinical Nutrition*, *71*: 1455–1461.

Lobato, L.P., Pereira, A.I.C., Lazaretti, M.M., Barbosa, D.S., Carreira, C.M., Mandarino, J.M.G. and Grossmann, M.E. (2011). Snack bars with high soy protein and isoflavone content for use in diets to control dyslipidemia. *International Journal of Food Sciences and Nutrition*, 1–10.

Miranda, M., Vega-Gálvez, A., Quispe-Fuentes, I., Rodríguez, M.J., Maureira, H. and Martínez, E.A. (2012). Nutritional aspects of six quinoa (*Chenopodium quinoa* Willd.) ecotypes from three geographical areas of Chile. *Chilean Journal of Agricultural Research*, *72*(2): 175-181.

Mirrahimi, A., Jekins, D.J., Srichaikul, K., Berryman, C.E., Wang, L., Carleton, A., Abdulnour, S., Sievenpiper, J.L., Kendall, C.W.C. and Kris-Etherton, P.M. (2010). Soy protein reduces serum cholesterol by both

intrinsic and food displacement mechanisms. *Journal of Nutrition*, *140*: 2302–2311.

Oladipupo, K.M., Edathil, A.A., Rambabu, K., Bharath, G., Banat, F., Nirmala, G.S. and Sathiyanarayanan, K. (2019). Extraction, characterization and optimization of high-quality bio-oil derived from waste date seeds. *Chemical Encountering Communications*, 1-11.

Padmashree, A., Sharma, G.K, Srihari, K.A. and Bawa, A.S. (2012). Development of shelf stable protein rich composite cereal bar. *Journal of Food Science and Technology*, *49*(3): 335-341.

Rehman, W.U, Shah, U., Rabi, K., Munir, M., Saleeem, A., Iqbal, A., Shah, F., Shah, S., Khan, Z.U., Hamayun, M., Hussain, A., Gul, H., Rauf, M. and Wang, L. (2020). Development of fiber enriched date bars from natural resources. *Fresenius Environmental Bulletin*, *29*(07): 6126-6133.

Shaheen, B., Nadeem, M., Kauser, T., Mueen-ud-Din, G. and Mahmood, S. (2013). Preparation and nutritional evaluation of date based fiber enriched fruit bars, *Pakistan Journal of Nutrition*, *12*(12): 1061-1065.

Stikic, R., Glamoclija, D., Demin, M., Vucelic-Radovic, B., Jovanovic, Z and Milojkovic-Opsenica, D. (2012). Agronomical and nutritional evaluation of quinoa seeds (*Chenopodium quinoa* Willd.) as an ingredient in bread formulations. *Journal of Cereal Science*, *55*: 132-138.

Vayalil, K. (2002). Antioxidant and anti-mutagenic properties of aqueous extract of date fruit (*Phoenix dactylifera* L.). *Journal of Agriculture Food Chemistry*, *50*: 610-617.

Vayalil, P.K. (2012). Date fruits (*Phoenix dactylifera* Linn): An emerging medicinal food. *Critical Reviews in Food Science and Nutrition*, *52*(3): 249–271.

Vega-Gálvez, A.V., Miranda, M., Vergara, J., Uribe, E. and Puente, L. (2010). Nutrition facts and functional potential of quinoa (*Chenopodium quinoa* Willd.), an ancient Andean grain: A review. *Journal of Science Food Agriculture*, *90*: 2541-2547.

Yadav, L. and Bhatnagar, V. (2015). Formulation and Sensory Evaluation of Ready-to-Eat Cereal Bars Made with the Raw and Processed Soya Flour. Trends in Biosciences, *8*(9): 2455-2459.

Yadav, L. and Bhatnagar, V. (2016). Formulation Quality Evaluation and Shelf-life of Value Added Cereal Bar by incorporation of Defatted Soy Flour. *International Journal of Food Fermentation Technology*, *6*(2): 251-259.

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