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SENSORY EVALUATION OF SWEET LUPIN AND FIELD PEA BLENDED *SHIRO* IN SELECTED DISTRICTS OF EAST GOJJAM ZONE, ETHIOPIA

***Abebaw Adamu Desalegn[1] and Anduamlak Assaye Mengesha[1]**

[1]Ethiopian Institute of Agricultural Research, DebreMarkos Agricultural Research Center

P.O. BOX 357; Debre Markos, Ethiopia

*Corresponding author: e-mail: abebawadamu@gmail.com

ABSTRACT

Sweet lupin has several nutritional and health benefits for human. It has also important role in improving soil fertility. Thus, this study was initiated to evaluate the acceptability of blended shiro of sweet lupin and field pea at different composition. The data were collected from randomly selected 90 panelists from East Gojjam Zone. The panelist's preference on the different proportion of sweet lupin and field pea blended shiro has been examined through a five-point Hedonic scale. Descriptive statistics analysis was used and the data were presented in tables, bar graph and figure. A Mann-Whitney U-test was deployed to determine whether there is a mean difference between rural and urban dwellers on color, taste, bitterness, texture and overall acceptability of 100% sweet lupin shiro. Of the total panelists, 47.80% were rural panelists and the remaining 52.20% were urban panelists. Generally, the result showed that the sweet lupin shiro has a possibility to substitute up to 100% field pea shiro preparation if spices are carefully prepared. The finding showed that blending of sweet lupin (SL) and field pea (FP)shiro at (75%SL: 25%FP; 50%SL: 50%FP and 25%SL: 75%FP) ratio and using purely 100%SL has acceptable taste, texture, color, bitterness and overall acceptability in Hedonic scales. Therefore, it is recommended that sweet lupin can substitute field pea and other expensive legume crops which are being used to prepare shiro.

Key words: East Gojjam; Hedonic scale; shiro; sweet lupin

INTRODUCTION

Lupin is an ancient crop that belongs to the annual legume crops. It was cultivated in ancient Greece and Egypt for human and animal consumption and cosmetic and medicine preparation ingredients before 2000 BC. Similarly, ancient Rome, South America and other Mediterranean countries were used lupin for soil fertility improvement, animal feed and human consumption (Van de Noort, 2017; Monteiro *et al.,* 2014).

For many years, the high levels of toxic and bitter-tasting alkaloids found in older lupin varieties which make it difficult to utilize for human consumption. However, due to the advancement of breeding technology in Germany, scientists developed less bitter often referred to as sweet lupin varieties (Abebe *et al.,* 2015). The development and improvement of alkaloid free lupin varieties and the increasing knowledge about the health benefits of lupin gave opportunities to some food processing companies in Europe and Australia to prepare and supply sweet lupin enriched foods.

Moreover, sweet lupin has several nutritional and health benefits. Foods enriched with sweet lupin have a positive effect on health and treatment of diseases (Sedláková *et al*., 2016). According to Department of Agriculture and Food Government of Western Australia (2008) sweet lupin have a very low glycemic index (GI) value, which have the potential to reduce the incidences of obesity, diabetes and cardiovascular diseases. Sweet lupin is gluten free and suitable for people with coeliac disease problems. Similarly, sweet lupin is so important in reducing of total cholesterol and hypertension, increasing satiety and lowering colon pH. Sweet lupin is also the best natural sources of both soluble and insoluble fiber and essential amino acids (Sipsas, 2010).

Several evidence-based studies showed that sweet lupin is rich in proteins, carbohydrates and micronutrients. For instance, a study conducted by Al-Zahrani (2019) reported that sweet lupin has contents of protein (32.37), fat (3.18), ash (1.25), fiber (4.99) and carbohydrate (51.43) mg/100gm of sweet lupin. Similar study conducted in Ethiopia revealed that sweet lupin (*welela)* variety contains 34.65 % of protein and 7.75 - 8.5% of oil. Moreover, the micronutrient composition of *welela* sweet lupin variety indicates Zinc (9.5), Iron (3.5), Calcium (27), Potassium (82) and Sodium (2.5) in mg/100gm (Kefale and Abrha, 2018). Relatively, a piece of similar evidence was recorded and reported by Abeshu and Kefale (2017) on the composition and contents of micronutrient of sweet lupin.

Furthermore, the Ethiopian traditional *shiro* (Ethiopian staple vegetarian gluten free spiced flour often used to prepare stew) is mostly prepared from legume crops including field pea, faba bean and chickpea. Even though, these legumes are important crops to fulfill the human protein requirements, they are characterized by low productivity and high price. According to (CSA, 2020) report, East Gojjam zone showed that the average yield of faba bean, field pea and chickpea was 2.23, 1.87 and 2.09 ton ha^{-1}, respectively. Besides, the zone productivity of legume crops is continuously declining due to the incidences of diseases and pests, frost, low soil fertility and high soil acidity (Ferede *et al.,* 2020). With this regard, sweet lupin has comparative advantage over other legume crops in terms of productivity and acid soil tolerant behavior. *Welela* variety of sweet lupin gives on average 2.6 tons ha^{-1} and it also performing well in acid-prone areas of Ethiopia.

The market price of field pea, faba bean, and chickpea is at rising trends. Therefore, the consumption and use of such crops used to make *shiro* is not economically feasible due to low productivity and high price in the market. Hereby, consumers are struggling to fulfill their daily *shiro* requirements by blending cheap legume crops. Thus, enriching *shiro* made from sweet lupin with field pea in different proportion ultimately improves the nutritional quality and

reduces the cost. Therefore, this demonstration research activity is initiated to encourage farmers to produce and use sweet lupin as alternative legume crop for *shiro* as well as to improve soil health. This research also gives a chance for both farmers and urban beneficiaries to prepare and use sweet lupin blended *shiro* at different ratios, without significantly affecting their preferences and purchasing power.

METHODS

Description of the study area

The research was undertaken in the East Gojjam zone of Amhara region, Ethiopia. The zone is organized from 18 rural districts and 5 town administrations. East Gojjam zone has huge potential for crop and animal production. The pulse crops production has been declined due to different factors like deterioration of soil fertility, expansion of soil acidity, and other natural and human- made problems. Most of the zone population livelihood is dependent on agriculture and agriculture related activities (Ferede *et al.,* 2020).

The first implementation site; Aneded district is located 17 km away from south east of Debre Markos (the capital city of East Gojjam zone) and 282 km away from Addis Ababa. The altitude of the district ranges between 1663-2570 masl with an erratic rainfall type (the annual rainfall 1200-1660mm). The annual temperature ranges between 10ºC to 22 ºC. According to Aneded District Agricultural Office (ADAO), the district has suitable agro-ecology for crop production and livestock rearing (ADAO, 2020).

The other implementation site, Gozamin district is one of the 18 districts in East Gojjam zone. The district is located 299 km away from Northern Addis Ababa. The altitude of the district is ranging 1000 to 3200 masl. Its annual average temperature ranges between 11.04 ºC and 25 ºC and annual average rainfall is ranged from 1448 to 1888 mm. Alike Aneded; Gozamin district has also suitable agro ecology for crop production and livestock rearing (GDAO, 2020). Debre Markos is the biggest and the capital city of East Gojjam zone and Gozamin district. The city is the center of social, political and economic activity of East Gojjam zone. It is home to many governmental and private technical and vocational colleges, universities and other institutes. Among these institutes, Washera Broad View College (WBVC) is one of the leading colleges which provide different academic courses in regular and continuing programs in diploma and degree levels. WBVC is also the other implementation site to conduct the research.

Sweet lupin *shiro* preparation procedures

The sweet lupin (*Welela)* variety was released in 2016 and field pea (*Billalo)* variety-released in 2012. The two varieties were collected from Technology Multiplication and Seed Research Process of Debre Markos Agricultural Research Center (DMARC) in 2020. The sweet lupin *Welela* is mainly released for human food.

A total of eight kilograms of raw sweet lupin and eight kilograms of field pea were used for the preparation of traditional Ethiopian *shiro*. The technical procedure of the *shiro* preparation is as follows. The sweet lupin was cleaned manually and soaked for 12 hours to remove its bitterness taste. Because soaking sweet lupins reduces the alkaloid content from 1.76% to 0.31% (Abeshu and Kefale, 2017). After 12 hours of soaking, it was drained and rinsed thoroughly then allowed to dry in sunlight. The dry sweet lupin was slightly roasted based on the Ethiopian traditional *shiro* preparation practice. The roasted sweet lupin was de-hulled by milling machine. The hull was removed from the grain by winnowing and manually. Only five kilograms of de-hulled sweet lupin were used for *shiro* preparation processes.

Alike sweet lupin, eight kilograms of cleaned field pea were slightly roasted and de-hulled by milling machine. The hull was removed from the grain by winnowing and manually. Only five kilograms of the de-hulled field pea was used for *shiro* preparation processes.

Four women were randomly selected to list the important type of spices and other ingredients for the preparation of *shiro*. The participant women are also expected to estimate the required amounts of spices for sweet lupin and field pea *shiro* flour preparation. The required amount and types of spices were purchased from the local market (Table 1). The preparation of spices was carried out on the basis of Ethiopian traditional spices preparation processes. The arranged spices were divided equally into two (half of for the sweet lupin and half for the field pea) parts. All the spices used to prepare *shiro* were measured and recorded. Finally, all the de-hulled sweet lupin and field pea were mixed with spices independently. The spiced splinted sweet lupin and field pea were tightly wrapped with plastic bags independently and waited for 24 hours. The process will help the aroma of the spices being absorbed by the splinted sweet lupin and field pea. After 24 hours, the wrapped spiced splinted sweet lupin and field pea were allowed to dry in sunlight. The dried splinted materials were milled to get fine flour of sweet lupin and field pea *shiro*. The *shiro* flour was passed through 0.5mm sieve to get finer and more suitable flour.

Two types of *shiro*; (100% sweet lupin *shiro* as well as 100% field pea) were prepared to carry out the sensory evaluation by incorporating at different ratio. The proportions are 100% sweet lupin, 100% field pea, 75% field pea and 25% sweet lupin, 25% field pea and 75% sweet lupin; and 50% sweet lupin and 50% field pea blended flours. The incorporated ratio of sweet lupin and field pea *shiro* was again labeled; coded and packed in plastic bags to carry out the evaluation.

Table 1. List of spices and its amount

No.	List of spices	Unit of measure	Amount	Remarks
1	Garlic	Gram	1500	
2	Rue	Gram	100	Wet fruit part
3	Basil	Gram	180	Fresh heads
4	Rosemary	Gram	165	Fresh leaves
5	Ginger	Gram	250	
6	Black cardamom seed	Gram	170	
7	Clover	Gram	30	
8	Cinnamon	Gram	40	
9	White cumin seed	Gram	25	
10	Black cumin seed	Gram	35	
11	Black pepper	Gram	40	
12	Long pepper	Gram	15	
13	Cumin	Gram	30	
14	Salt	Gram	250	

After preparation of all required amounts of sweet lupin and field pea flours; *shiro* stew was prepared to conduct the sensory evaluation. The recipes used to prepare *shiro* stew were onion, cooking oil, spiced pepper powder and salt for taste. *Shiro* stew was prepared from each labeled *shiro* type by estimating the number of panelists. The *shiro* stew was prepared by following the Ethiopian traditional *shiro* stew preparation practices and procedures. The five blended *shiro* types were prepared by mixing the field pea and sweet lupin in different proportions. These proportions are 100% sweet lupin, 100% field pea, 75% field pea and 25% sweet lupin, 25% field pea and 75% sweet lupin; and 50% sweet lupin and 50% field pea blended flours. Among these blended processes, the five types of shiro stew were prepared and served with *injera* (local

flatbread made from tef/ *Eragrostis tef*). The data collection was undertaken by the researchers from Debre Markos Agricultural Research Center using semi-structured interview schedule and a five-point Hedonic scale for the sensory evaluation just after each *shiro* type is served.

Data sources and collection

Among the potential sweet lupin producer districts, Aneded and Gozamin districts were randomly selected. In addition, Washera Broad View Collage (WBVC) was selected purposively due to its urban academic and administrative staff profile and willingness of the college and staffs to participate on the sensory evaluation process. However, panelists were selected randomly based on their interest to test and evaluate the blended materials. A total of 43 farmers were selected randomly from Aneded and Gozamin districts to administer a semi-structured interview schedule. Forty-seven panelists were selected randomly from WBVC composed of students, academic and administrative staffs. All panelists were voluntarily agreed to test and evaluate the blended materials. The interview schedule was designed to explore the general information about the household's socio-demographic characteristics and to evaluate panelist's preference towards the blended materials using five-point Hedonic scales.

Both qualitative and quantitative data were collected through a semi-structured interview schedule for untrained panelists. Primary data were collected from the sampled respondents through interview schedules and focus group discussions. Similarly, secondary data were gathered from published documents and different reports. Moreover, the participant meeting was arranged before blended *shiro* stew testing is commenced so as to create awareness about the blended field pea with sweet lupin *shiro* stew and its nutritional values. Then, participants were expected to test and evaluate different blended sweet lupin *shiro* stew for taste, texture, color, bitterness and overall acceptability on the basis of Hedonic scales.

Method of data analysis

The collected primary data were coded and entered into Statistical Package for Social Science (SPSS version 25.0). All statistical tests were deployed. Besides, the data obtained from the sample respondents were analyzed through a descriptive statistical analysis. Descriptive statistics including frequency, mean and percentage were analyzed. The data were presented using tables and bar graphs and figures. Statistical Mann Whitney U-test was used to make a comparison of mean rank and tests the significant levels of sample households on color, texture, taste, bitterness and overall acceptability of blended sweet lupin *shiro* stew.

RESULTS AND DISCUSSION

Demographic characteristics

Among all panelists, 47.8% were rural farmers and 52.2% are urban dwellers. Of all panelists, 51.1% were male and 48.9% were female. As indicated in Table 2, the average family size of the panelists is 3.94. The majority of the panelists (63.30%) were married. Regarding to the educational status of panelists, around 47.8% had received college diploma and university degree. 11.10% of the panelists able read and write through informal ways. About 22.20% of the panelists were not attending formal or informal education.

Table 2. Socio demographic characteristics of participant

Variables	**n**	**Mean or % (SD)**
Age	90	34.86 (10.37)
Family Size	90	3.94 (2.29)
Educational background		

Not able to read and write	20	22.20
Able to read and write	10	11.10
Received primary school	10	11.10
Received secondary school	7	7.80
Received college diploma and above	43	47.80
Marital status		
Single	30	33.33
Married	57	63.33
Divorced	2	2.22
Widowed	1	1.12
Sex		
Male	46	51.10
Female	44	48.90
Residence		
Urban	47	52.20
Rural	43	47.80

Sensory evaluation of blended *shiro* composition

The participants were asked to rate the samples for taste, color, texture, bitterness, and overall acceptability on a five-point Hedonic scales (5=Like very much, 4= like slightly, 3= neutral, 2= dislike, and 1= dislike very much). The sensory evaluation activities of blended *shiro* composition were evaluated by both rural and urban dwellers of Aneded and Gozamin districts of East Gojjam Zone, Amhara region.

Color

Color is a key quality trait of different compositions of food and food items that has a visual impact on the sensory evaluation of the people. It indicates the quality of the starting materials of the products. Based on this, the result of the study showed that the color of sweet lupin and field pea blended *shiro* has different evaluation results (Fig. 1).

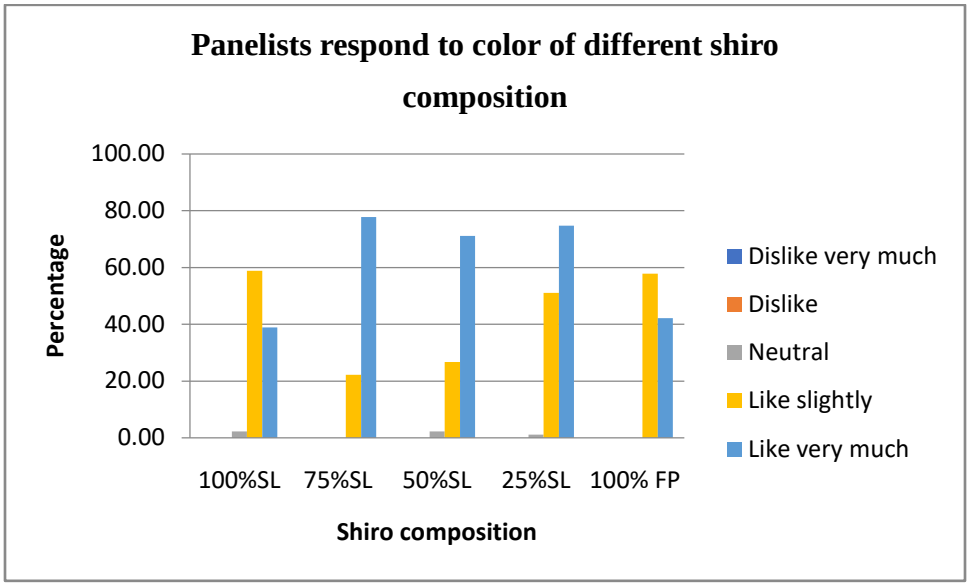

Figure 1. Panelists' response to color of different *shiro* composition

The result of the study revealed that more than 70% of the panelists were accepted the color of the blended sweet lupin with field pea at (75%SL: 25%FP and 50%SL: 50%FP ratio) composition. This implies that the sample households didn't have a significant complain on the color of sweet lupin and field pea blended *shiro* at more than 50% ratio of sweet lupin is added in the compositions. This study has consistent results with a study done by Abebe *et al.* (2015) on sweet lupin blended *shiro* composition.

Taste

According to the panelists, about 80% of the respondents replied that 75%SL: 25%FP ratio of the blended *shiro* taste is a highly accepted composition. The study also indicated that 75%SL: 25%FP *shiro* composition has more preferable taste than 100% field pea shiro. Currently, in the study area the production of pulse crops have gradual reduction in terms of area coverage and yield due to the prevalence of pests, reduction of soil fertility and expansion of soil acidity (Ferede *et al.*, 2020).

Texture

Texture is an important quality attribute in the production and use of food products. This study indicates that the texture of the 100% sweet lupin and 100% field pea are equivalent. Hence, the consumers have an equal opportunity to use either sweet lupin or field pea to obtain texturally acceptable level. The study also indicates that the texture of the product of the *shiro* increases with decreasing amount of the sweet lupin ratio.

The lowest mean value of textural properties of 100% SL *shiro* is due to the fact that naturally sweet lupin has more than 7% oil content which is difficult to get finer product during milling process. It was observed that when the milling machine is adjusted in order to obtain finer powder, the *shiro* powder was very hot when compared to field pea. Even though, the texture of 100% sweet lupin took the lowest mean value; panelists claimed that it is acceptable. A farmer from Gozamin district informed that;

> *"It is hard time to obtain and feed our families good quality shiro stew. The price of field pea is going high. The higher budget is allocated for shiro. To be frank, if Debre Markos Agricultural Research Center is providing evidence on the benefit of sweet lupin for human nutrition; especially for shiro, we are committed to produce and use it."*

Bitterness

The result showed that most of the panelists replied that the 75%SL: 25%FP has no significant difference in the bitterness when it is compared with 100% field pea.

Table 2. Comparison on participants` sensory evaluation of sweet lupin *Shiro*

Testing parameters	Participants				U-test
	Rural		Urban		
	Mean rank	Sum of ranks	Mean rank	Sum of ranks	
Taste	55.90	2403.50	35.99	1691.50	563.50***
Color	45.81	1970.00	45.21	2125.00	997.00
Texture	48.44	2083.00	42.81	2012.00	884.00
Bitterness	50.83	2185.50	40.63	1909.50	781.50**
Overall acceptability	54.79	2356.00	37.00	1739.00	611.00***

A Mann-Whitney U-test was conducted to determine whether there is a difference in 100% sweet lupin taste values between rural and urban panelists. The result of this study showed that the mean rank of the rural panelists (55.90) was greater than mean rank of urban panelists (35.99). This result also indicates that there is a significant median difference between groups (rural and urban panelists, (U=563.50, *P<0.001)* among the taste of 100% sweet lupin *shiro*.

According to Table 2, the bitterness of 100% sweet lupin has a significant median difference between rural and urban panelists at less than 5% significant levels (U=781.50). This indicates that the rural panelists much more like the bitterness of the sweet lupin *shiro* than urban panelists. Similarly, the overall acceptability of the 100% sweet lupin indicates that there was a median difference between the panelist groups at less than 1% significant level. We conclude that the rural panelists were much more like the 100% sweet lupin *shiro* than with that of the urban panelists.

Generally, the result showed that the sweet lupin *shiro* has the possibility to substitute up to 100% field pea *shiro* preparation if spices are carefully prepared. This implies that substituting of other legume crops which are used to prepare *shiro* with sweet lupin has economic and nutritional benefits.

Participants` technology demand

After the sensory evaluation is completed, panelists were asked different statements about sweet lupin. The data showed that 90% of the panelists didn't have information about the sweet lupin recipe preparation and itself before. Panelists were also asked whether they ever tested sweet lupin at any form; majority of the panelists (93.3%) didn't test sweet lupin before. Among farmer panelists, almost all (97.33%) didn't have experience in sweet lupin production (Table 3).

Table 3. Participants experience and willingness to selected variables

Variables	n	Percent
Sweet lupin cultivation Experience _ Rural dwellers (no)	42	97.33
Willing ness to prepare and use sweet lupin for *shiro* in the future (yes)	86	95.60
Willingness to cultivate sweet lupin _rural dwellers (yes)	43	100.00
Test experience of sweet lupin in any form (no)	90	93.30
Willingness to buy and use sweet lupine *shiro*_ urban dwellers (yes)	44	93.60

Panelists were also asked whether they prepare and use sweet lupin for *shiro* in the future if the product is available, 95.60% claimed that they will prepare and use sweet lupin for *shiro*. Only 4.40% are not interested to prepare and use sweet lupin for *shiro* (Table 3). All participant farmers showed interest to produce sweet lupin if they get training and seed available.

CONCLUSION

Sweet lupin is an important legume crop for human and animal nutrition and improves soil fertility. The yield of major legume crops in East Gojjam zone has been declining due to various factors. Expansion of soil acidity problems, diseases and insect pests are the major bottlenecks. Following the low productivity of legume crops, the price of field pea is being unaffordable for

smallholder farmers and pro-poor urban residents. As a result, farmers and urban residents are able to substitute expensive legume crops with other cheap legume crops. The finding showed that blending of sweet lupin and field pea *shiro* at (75%SL: 25%FP; 50%SL: 50%FP and 25%SL: 75%FP) ratio and using purely 100%SL has acceptable taste, texture, color, bitterness and overall acceptability in Hedonic scales. Therefore, we are confidently recommended that sweet lupin can substitute field pea without affecting consumers' taste, texture, color, bitterness and overall acceptability of the recipe.

REFERENCES

Abebe, Y., Ahmed, A., Tafere, M., Dagnew, S., Gebre Selassie, Y., Yeheyis, L., & Molla, D. (2015). Best fit practice manual for sweet lupin (Lupinus angustifolius L.) production. *BDU-CASCAPE working paper*, *11*.ADAO (Andede District Agricultural Office). 2020.

Abeshu, Y., & Kefale, B. (2017). Effect of some traditional processing methods on nutritional composition and alkaloid content of lupin bean. *International Journal of Bioorganic Chemistry*, *2*(4), 174-179.

Al-Zahrani, M. T. (2019). Development of Fortified Laddoo with Sweet Lupine. International Journal of Engineering Research & Technology (IJERT). ISSN: 2278-0181. Vol. 8 Issue 12, December-2019

ADAO (Andede District Agricultural Office). (2020). Andede District Agricultural Office Annual Report. Unpublished.

Central Statistical Agency. (2020). Agricultural Sample Survey 2019/20 (2012 E.C.) Volume I Report on Area and Production of Major Crops. https://www.statsethiopia.gov.et/wp-content/uploads/2020/04/Report-on-Area-and-production-of-major-crops-2012-E.C-Meher-season.pdf. Accessed on 09 September 2021.

GDAO (Gozamin District Agricultural Office). (2020). Gozamin District Agriculture Office Annual Report. Unpublished.

Ferede, S., Yirga, C., Kehaliew, A., Agegnehu, G., and Alemu, T. (2020). *Farming Systems Characterization and Analysis in East Gojjam Zone: Implications for research and development (R&D) interventions*. Ethiopian Institute of Agricultural Research

Kefale B, and Abrha E. (2018). Sweet lupine recipe development and nutritional content of recipe at Holeta, Ethiopia. Journal of Food Science and Nutrition Therapy. 4(1): 009-011. DOI: http://dx.doi.org/10.17352/jfsnt.000014

Monteiro, M. R. P., Costa, A. B. P., Campos, S. F., Silva, M. R., da Silva, C. O., Martino, H. S. D., & Silvestre, M. P. C. (2014). Evaluation of the chemical composition, protein quality and digestibility of lupin (Lupinus albus and Lupinus angustifolius). *O Mundo da Saúde, São Paulo, 38*, 251-259.

Sedláková, K., Straková, E., Suchý, P., Krejcarová, J., & Herzig, I. (2016). Lupin as a perspective protein plant for animal and human nutrition–a review. *Acta Veterinaria Brno*, *85*(2), 165-175.

Sipsas S. (2010). Australian Sweet Lupin. Health report. https://www.wheat-free.org/documents/Lupin%20Flour%20Health%20Report%20V%201.pdf. Accessed on 07 September 2021.

Van de Noort, M. (2017). Lupin: an important protein and nutrient source. In *Sustainable protein sources* (pp. 165-183). Academic Press.