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Development of nutrition rich food product using alfalfa sprouts powder

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Abstract
Alfalfa (*Lucerne* and *Medicago sativa*) is the herb and corresponding legume seeds are of family Fabaceae. It is cultivated as an important forage crop in many countries around the world. Alfalfa is used as a food material since a long period due to variety of its nutritional benefits and properties which include high protein content, vitamins, and minerals. The sprouts of alfalfa are also gaining much popularity these days because of their nutritional properties and high antioxidant content. The major drawback related to this sprout usage is the small shelf life of the sprouts. Limited studies have been reported earlier to increase the shelf life of the sprouts for making it available for a wide group of population for a longer period of time. Present review focuses on obtaining the sprouts in consumable form for a longer period of time and increasing its shelf life to make the nutritional benefits available to wider group of the population.

Keywords: Alfalfa, drying methods, product formulation, shelf life

Introduction
Alfalfa (Lucerne and *Medicago sativa*) originated in South-Central Asia, and it was first cultivated in ancient Iran and Australia. There are four kinds of alfalfa sprouts in Australia, which are easily available in different states of Australia, and their democratic levels are also different (Table 1), (Apostol *et al*., 2017) [2]. Alfalfa is the most widely planted forage legume in the world. It is considered an excellent legume forage crop all around the world **(**Undersander *et al*., 1997) [1]. Global production of alfalfa was approximately 436 million tons in year 2006. In 2009, alfalfa grew to about 30 Million hectares worldwide; North America contributed for 41% of total production (11.9 million hectares). Alfalfa protein has powerful functional properties and many applications in the pharmaceutical field: for example, its antioxidant properties can be beneficial in treating diabetes. According to reports, the protein content of bean sprouts is 150% higher than that of soybeans, and cereals, such as wheat, oats, and corn.

Alfalfa sprouts reported to contain more vitamin C and riboflavin and good sources of minerals such as calcium and iron (Elwood *et al*., 1971) [15].

Glucose sugar is the main chemical energy product of photosynthesis. Glucose combines with other nutrients and provides all required components for alfalfa growth. Alfalfa seed needs nitrogen and phosphorus, potassium, sulfur, calcium, magnesium, iron, boron, manganese, zinc, copper, molybdenum and some others micro-nutrients to promote the growth. These nutrients are absorbed together with water via roots from the soil. Little more trace minerals may be absorbed through leaves, if the foliar surface is smeared (Under Sander *et al*., 1997) [1]. Usually, the seeds of alfalfa start germinating after complete absorption of around 125 percent by weight of water. The swelling of seed causes seed coat to break and alfalfa germinates between optimum temperature ranges between 18 to 25 ºC. The rate of germination is found to increase with increase in the soil temperature, as the metabolic rate of activities in seed increases. The plantlet growth phase is also known as establishment phase which includes the time period between the emergence of the seedling and first harvest. The first true leaf has just a single leaflet, while the second leaf contains trifoliate leaf. Second stage is followed by five leaf stage and a leaf is considered to be fully expanded when the outer edges of all leaflets are no longer touching.

The re-growth after cutting is seen in case of alfalfa primarily via crown buds and axillary buds.

The forage quality of alfalfa starts going down soon after harvesting. The goal for many is to reduce the spoilage rate and loss of the crop. For this purpose, many methods have been used including curing, conditioning, and application of various drying agents to the harvested crop. Although various methods have been applied and many of them are still being discovered, no proper method has been found which can lead to minimum post-harvest loss.

Table 1: Varieties of Alfalfa native to Australia

Sr. no.	Varieties of alfalfa	Region	Dormancy rating
1	Sardi-Grazer Lucerne	All state Australia	6
2	Sardi-7 Lucerne	All state Australia	7
3	Genesis Lucerne	All state Australia	7
4	Sardi-10 Lucerne	All state Australia	10

Seeds

In the absence of light conditions, alfalfa seeds germinated for 72 and 120 h (Hamilton *et al*., 2016) [16]. Seedling growth is the period of development from the completion of germination to the development of young plants that can germinate. Make enough food through photosynthesis to sustain growth (Mayer, 1999) [22]. Alfalfa seeds are usually kidney-shaped, small, yellowish brown to olive green. River seed includes two cotyledon (embryo), radicle, hypocotyl (the area of the root of the radicle below the cotyledon), and epicotyl (embryo form stem) (James *et al*., 2009) [20].

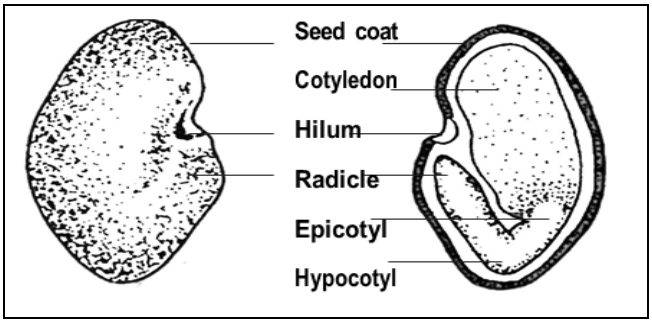

Fig 1: Morphology of Alfalfa Seed (Hall *et al*., 2011)

Sprouts

Alfalfa sprouts provides oral-based supplements to individuals or as a food additive. Especially alfalfa leaves have huge potential for human use due to their nutritional value and high protein yield per hectare (Wang *et al* 1976) [18]. Alfalfa can be used as an effective functional ingredient for diet prevention and treatment of various metabolic diseases, especially metabolic syndrome (Bora and Sharma, 2011) [19]. Leaves of alfalfa, in particular, have significant potential for human use due to their nutritive value and their high yields of protein per hectare (Pirie, 1972) [26].

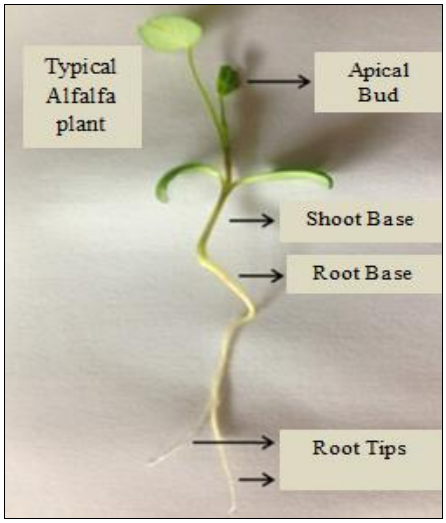

Fig 2: The parts of an alfalfa plant (Under Sander *et al*., 2011) [27]

Sprout Powder

Alfalfa helps to reduce certain risk factors for cardiovascular disease. Alfalfa sprouts powder is used in all types of food as food additives in a sufficient quantity to reduce the risk factors for cardiovascular disease (Hong *et al*., 2009) [11]. The powder is very effective for your immune system. Those with cholesterol problems, hair loss, and menopausal symptoms are especially interested. Alfalfa meal has many effects of lowering blood pressure and anti-inflammatory.

Fig 3: Alfalfa Dried Powder

Table 2: Proximate nutritional composition of alfalfa sprout powder

Sr. No.	Test Parameter	Sprout powder (100 gm)
1	Protein	35.206%
2	Fiber	8.5%
3	Carbohydrate	36.094%
4	Energy value	297.8%
5	Ash	13.4%
6	Moisture	5.4%
7	Fat	1.4%

Table 3: Nutritional composition of fresh alfalfa sprouts (Apostol *et al*., 2017) [2]

Sr. No.	Nutrition	Sprouts
1.	Energy	23 calories
2.	Carbohydrates	2.1 gram
3.	Dietary fiber	1.9 gram
4.	Fat	0.7 gram
5.	Protein	4 gram
6.	**Vitamins**	
	Vit.B1 (Thiamine)	7%
	Vit.B2 (Riboflavin)	11%
	Vit.B3 (Niacin)	3%
	Vit.B5 (Pantothenic acid)	11%
	Vit.B6	3%
	Vit.B9 (Folic acid)	9%
	Vit.C (Ascorbic acid)	10%
	Vit K	29%
7.	**Minerals**	
	Calcium	3%
	Iron	7%
	Magnesium	8%
	Manganese	9%
	Phosphorus	10%
	Potassium	2%
	Zinc	10%
	Sodium	0%
	Water	93 gram

Health benefits

Help to increase breast milk production

Beans sprouts contain a substance found in certain plants which can produce estrogen hormones when ingested into the body, spooning, and the amino acid L-canavanine those are believed to make more actives in breast milk production. In many other cultures, women who have babies usually consuming this kind of herbs to increase and promote the level of breast milk production. In alternative medicine literature, traditional scientific evidence is shared but some Alfalfa has been found in some milk Powder and mixture (Alachkar *et al*., 2011) [24]

Lower cholesterol and improve heart health

The first six weeks studies in Europe in the 1990s found that the average decrease in LDL (Low Density Lipoprotein) cholesterol increase in good or HDL cholesterol was 11.2% after that in 2016 there was conducted another study on 15 people which has shown similar results reducing bad cholesterol by 18% and after that on many animals studies have shown similar effect (Dixit *et al*., 1990) [5]. Because it contains a large number of saponins in plants may serve as antifeedants and protect this plant against microbes and fungi. Alfalfa sprouts can trigger this reaction from the body when they contain a large number of saponins. Saponins can get bind to cholesterol via bile. This does not allow cholesterol to be reabsorbed as in this case cholesterol is reduced and it is excreted (Vinarova *et al*., 2015) [6]

Helps rid of kidney stones

Diuretics are something that we can call a water pills because they may increase the level of excretion of water and salt. As Alfalfa is a good source of Diuretics. This also releases sodium in the urine. A diuretic is a condition in which the kidney filters too many bodily fluids, which increases your urine production and helps to clear uric acid (kidney stones) this can be seen in some people in which can go through severe pain (Malinow *et al*., 1981) [7] again some studies lack human trial and promising in this area. Alfalfa is widely used for remaining kidney stones in the alternative literature (Kelly *et al*., 1999) [31].

Improves metabolic health and activity

Alfalfa has many metabolic benefits because studies conducted in Diabetes Miscellaneous have found that alfalfa has different mechanisms for stabilizing blood sugar levels. Alfalfa sprouts can improve metabolic health and lower blood sugar levels. This results in the release of the hormone insulin from the pancreas into the lower blood. Even in traditional and indigenous societies, this can lead to lower blood sugar levels. In American Indian and Indian cultures, alfalfa is widely used to control blood sugar levels. (Seida *et al*., 2015) [10].

Reduce chronic diseases by antioxidant activity

It is believed that alfalfa sprouts can reduce the number of free radicals in the body, so it provides long-term benefits in reducing redness, swelling, fever, and frequent pain (inflammation) in body parts, mainly in response to injury or infection (Hong *et al*., 2009 year) [11]. Many chronic diseases have been found to be positively correlated with chronic long-term inflammation. Reducing inflammation can help prevent diseases such as Alzheimer's disease, Parson's disease, cancer, diabetes, and heart disease (Gray *et al*., 1997) [21]

Stabilize blood sugar

Alfalfa used to slow the intestinal absorption of glucose. Alfalfa is a good source of fiber-rich foods. This helps control blood sugar levels. Therefore, it may help control diabetes and prediabetes.

Risks and side effects of alfalfa sprouts

Although the U.S. Food and Drug Administration (FDA) recognize that alfalfa sprouts are safe for example

(Pregnancy, lupus, etc.) certain diseases are related to certain medical conditions, Humid and favorable conditions. For people with weakened immunity, it may cause slight irritation to the immune system (Dechet *et al*., 2014) [12]. The best practice is to thoroughly rinse the sprouts at least 3 times the germination period.

Pregnant women should avoid alfalfa sprouts

Alfalfa sprouts contain a lot of phytoestrogens and may also increase estrogen. The content in the system, because it is good to strictly avoid the alfalfa sprouts of pregnant women. They also sometimes cause urine to shrink (Ernst *et al*., 2002) [14].

If you are using thinner, please avoid using alfalfa

Because alfalfa sprouts are rich in vitamin K, they sometimes change certain metabolisms. Avoid using alfalfa for blood thinning drugs. If you are using thinners, especially if you have thicker blood thinners, you should avoid using it. It may cause blood clots due to vitamin K, which is the opposite of the effect of blood thinners (Mousa *et al*., 2010) [13].

Can trigger lupus

Originally healthy bean sprouts contain a specific amino acid called L-canavanine, which can cause autoimmune diseases (Lupus). It may also cause inflammation in patients with lupus. Alfalfa sprout gas is an excellent antioxidant and is very beneficial to health. However, since you have any autoimmune disease or any disease similar to multiple sclerosis or lupus, it is best to treat it and strictly avoid alfalfa sprouts.

Table 4: Use of alfalfa sprout powder in food product development

Raw material	Food product development	Major finding	Reference
Alfalfa powder	Water extraction juice	Water-based	Lorga *et al*., 2017 [28]
Alfalfa liquid extract	Pure Alfalfa liquid extract	Liquid extract	Amraie *et al*., 2015 [29]
Alfalfa Sprout beans	Sprouted beans and seeds	Sprouts of seed	Lister *et al*., 2006 [30]

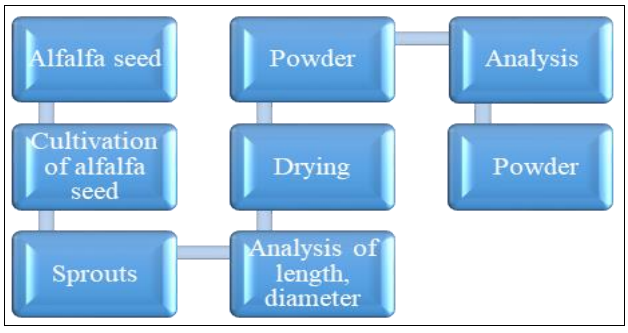

Fig 4: Complete process of powder production from grown alfalfa sprouts

Cultivations

Alfalfa seeds were purchased from the Indian market at a price of 250g/250 rupees. The alfalfa seeds are germinated by vertical tillage, and 60 alfalfa seeds are placed in the germination tray for germination. Use cocoa peat instead of soil. Alfalfa seeds begin to germinate after 24 hours. After 4 to 5 days, complete germination of alfalfa seeds was observed. Among the 60 seeds, only 40 seeds germinated. The mature alfalfa sprouts are collected manually, and the length and diameter of the sprouts are calculated with a scale and a vernier caliper. Clean the cocoa peat particles by washing the bean sprouts with tap water. Use OTG (oven grill) to dry alfalfa sprouts at 40-45 ºC for 5-6 hours. Then use a grinder to grind the dried bean sprouts. Then store the powder in HDPE bags at room temperature.

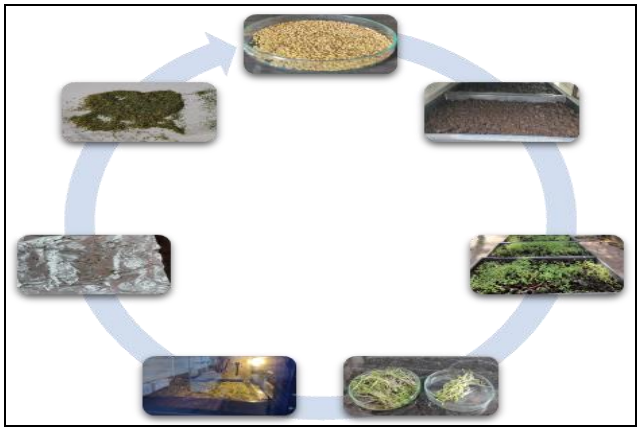

Fig 5: Complete process of cultivation and powder production from grown alfalfa sprouts

Future scope and perspectives

Future scope involves the accomplishment of goals including the infusion of dried alfalfa powder in any ready-to-consume foods for all age groups with relatively higher stability and maximum nutritional benefits, to determine the cost-effectiveness of alfalfa-formulated food items in comparison to the same category available in market, to determine the nutritional benefits of a formulated food item and to make the formulated item readily accessible to consumers.

Conclusion

Alfalfa is a highly nutritious food legume having numerous health benefits and advantages for all age groups of the population. The nutritional qualities include high antioxidant activity, high vitamin and mineral content, fiber, and protein content. The major problem associated with the availability of alfalfa is the relative instability of the sprouts and high spoilage rate. Various methods have been adapted to solve these problems which include traditional and modern drying methods but no method till date has been found to provide a satisfactory data for further use of this beneficial plant. The drying method discussed in the paper can turn out to be useful for increasing the availability of alfalfa sprouts at a higher rate to food market. Formulation of any quickly accessible product can make it easy for the population to accept the product at larger rate and this can impart number of health benefits to all age groups.

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Conflict of interest

All the authors declared that there is no any financial

conflict among the contributors.

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