

CHEMICAL EVALUATION OF LUPINE SEEDS
DURING GERMINATION

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ABSTRACT

Chemical composition and some antinutritional factors of lupine seeds variety "Giza 1" were evaluated periodically by 24 hours intervals for 7 days of germination.

It has been found a significant gradual decreases in dry matter, total carbohydrates, crude fibres content and antinutritional factors such as trypsin-inhibitor activity and total vicine during germination period. These decreases were accompanied with significant increment in albumins and globulins (the major protein fractions), RNA, soluble non protein nitrogen, reducing and total sugars.

Lupine seeds germinated for 5-6 days were characterized by relatively highest percentages of nutritional compounds such as lipids, crude protein, ash, soluble sugars, and the lowest amounts of antinutritional factors such as nucleic acid DNA, trypsin-inhibitor activity and total vicine and convicine. These results indicated clearly that germination for 5-6 days led to improve the nutritive value of lupine seeds.

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INTRODUCTION

The lupin (*Lupinus termis* L.), a leguminous plant, has a great potential as an available crop grown in regions having a temperate climate. Lupine seeds are used as human food after leaching the toxic alkaloids with water particularly in Egypt, Sudan, Ecuador, Peru and Bolivia.

Cerletti and Duranti (1979); Mangold (1981) mentioned that lupine seeds contain 10-20% oil and up to 40% protein which has no leguminous taste because of its deficient in sulfur amino acids. They also stated that lupine plants can be used in animal feeding and as organic fertilizer in reclaimed soils.

There are many available informations about improvement the nutritive value of seeds by reducing some of the anti-nutritional factors such as trypsin inhibitor (Hobday *et al* 1973); phytate content (Reddy *et al* ., 1978), total vicine and convicine (Abulseoud, 1984) in germinated seeds but not throughout germination. According to our knowledge there are no available data about the types of changes in carbohydrate and protein fractions, lipids and ash contents as well as protein inhibitors during germination of lupin seeds. Therefore, the aim of the present investigation was to evaluate the chemical composition and some antinutritional factors of lupine seeds variety "Giza 1" daily throughout the germination process.

MATERIAL AND METHODS

Materials :

Lupin seeds variety "Giza 1" were obtained from Agric. Res. Cent., Giza, Egypt. Seeds in two replications were germinated on wet filter paper for 7 days. Samples from germinated seeds were taken daily, dried in an electric oven at 50°C, dehulled and fine grinded before subjecting to chemical determinations. Two samples were analyzed at zero germination time as a control.

Evaluation of lupine seeds during germination.

Analytical methods :

1. Dry matter content at 105°C, lipids, soluble non protein nitrogen (NPN), total nitrogen, total carbohydrates and its fractions including reducing, non reducing and total sugars were determined using official methods as reported by AOAC (1975). The results were calculated as percentage on dry matter basis, crude and true proteins were calculated by multiplying percentage of total nitrogen and protein nitrogen by 6.25, respectively.
2. Protein fractions such as albumins, globulins, prolamins, glutelins and non soluble protein (NSP) were estimated using solvent extractions, i.e., potassium sulfate (5%) (pH 5.8), ethyl alcohol 70% and sodium hydroxide 0.2% (Pleshkof, 1976). The results were calculated as percentage of true protein.
3. DNA and RNA were determined according to Parijs (1967) and the data were calculated as mg P/gm dry sample.
4. Trypsin inhibitor activity (TIA) was estimated by the method of Roy and Bhat (1974) and calculated as mg TIA mg/gm dry sample on the basis that 1.9 trypsin inhibitor units (TIU) is equivalent to 1 ug TI (Kakade *et al.*, 1969). Total vicine content (mg/gm dry sample) was measured according to Collier (1976).

Statistical analysis :

The experiment was arranged in complete randomized design in two replications. The results were exposed to the proper statistical analysis of variance according to Snedecor and Cochran (1969). L.S.D. test at 5% level of significance was used for comparison between means.

RESULTS AND DISCUSSION

The data in Table (1) show that there was a relative and significant reduction in the dry matter content during the first 5 days of germination. This reduction indicated active mobilization and consumption of some of the stored materials in cotyledon. It might also be due to high water

absorption which led to increase fresh weight of seedlings.

During germination, crude protein content decreased gradually and significantly to its minimal value throughout the first three days being 44.6 and 40.7% at the beginning and after 3 days of germination, respectively. Opposite trend was observed when the seedling reached 4 days old followed by slight changes up to 7 days old.

Table (1): Some chemical constituents of lupine seeds during germination.

Germination (days)	Dry matter	Lipids	Crude protein	Ash	Crude fibers
0	84.15	14.43	44.56	3.36	2.47
1	69.39	14.39	44.24	3.78	2.24
2	37.53	15.08	41.87	3.74	2.07
3	33.21	15.08	40.78	3.99	1.76
4	31.77	15.23	45.58	3.30	1.67
5	28.62	14.90	44.56	4.00	1.44
6	28.71	14.56	46.10	3.89	1.00
7	28.35	15.52	45.80	3.76	0.56
L.S.D. at 5%	2.06	1.13	2.42	NS	0.52

The available data in Table (1) show a slight decrease in crude fibers content during the first three days and was significantly reduced by advancing the seedling age up to 7 days. These decreases were from 2.47% down to 0.56% at the beginning and after 7 days of germination.

These results coincide with those obtained by Abdel-Hamid *et al.*., (1981). They concluded that germination required mobilization and consumption of some of the stored materials in cotyledons mainly protein and carbohydrates.

On the other side, lipids and ash contents were not statistically affected after one day till 7 days of germination period (ranging between 14.39 to 15.52% and 2.99 to 4.0%, respectively).

Evaluation of lupine seeds during germination.

Table (2) indicates clearly that total carbohydrates content had gradual significant decrease during the stage of germination reaching its minimal value after 7 days. These decreases could be attributed to their mobilization and consumption during the period of germination.

Regarding the data, a negative relationship was observed between total carbohydrates content and both reducing and total sugars during the first two days of germination. The degradation of polysaccharides under the effect of amylase enzymes occurred and subsequently total sugars content was increased. Opposite phenomena was obtained throughout the third and fourth days of germination. Minimum reducing sugars and maximum non reducing sugars content were obtained after 5 days of germination being 0.88 and 6.5% respectively. After 7 days of germination, reducing sugars constituted most of the total sugars which reached 7.23%, while non reducing sugars was 0.52%. These results could be attributed to the differentiation of seedling and formation of primary leaves. These leaves started biosynthesis of sugar molecules and subsequently increased reducing and total sugars.

Table (2): Carbohydrate fractions of lupine seeds during germination.

Germination (days)	Total carbohydrates (%)	Sugars (%)		
		Reducing	Non- reducing	Total
0	27.37	2.93	3.18	6.11
1	26.22	5.07	2.16	7.23
2	25.40	5.37	2.79	8.16
3	24.87	0.92	6.05	6.97
4	24.28	0.92	4.09	5.01
5	23.04	0.88	6.50	7.38
6	21.53	5.37	0.70	6.07
7	20.78	7.23	0.52	7.75
L.S.D at 5%	1.96	0.82	0.97	0.88

Table (3) presents non protein nitrogen and protein content in dry matter as well as the protein fractions calculated as percentage of protein. A descending trend was noticed for protein fractions of seeds and seedlings during all germination periods as follows: Albumins, globulins, non soluble protein, glutelins and prolamins.

It is noteworthy that albumins and globulins represent the major proportion of protein. Such results are in agreement with those of Fox *et al* (1964) who showed that albumins and globulins form always the major fractions in comparison to prolamins and glutelins in leguminous seeds.

During germination, albumins and globulins increased significantly and reached their maximal values (58.94 and 23.18%) at the third and fourth day, respectively. Gradual reduction was observed in both fractions as the time of germination progressed to reach 51.26 and 12.98% 7 days after germination.

Prolamins were decreased significantly after one day during germination followed by statistically stable amount. Meanwhile, glutelins were generally and significantly decreased as germination progressed (after 6 and 7 days).

Table (3): Protein fractions of lupine seeds during germination.

Germination (days)	NPN (%)	Protein (%)	Protein fractions(% of protein)				
			Albu- mins	Globu- lins	Prola- mins	Glue- lins	NSP
0	1.38	35.93	54.65	17.10	2.35	9.78	16.12
1	1.36	35.74	55.58	19.63	1.14	8.10	15.55
2	1.44	32.87	58.65	21.66	1.63	8.05	10.01
3	1.75	29.84	58.94	20.14	1.24	8.18	11.50
4	1.98	33.21	51.80	23.18	1.14	8.48	15.40
5	1.60	34.56	51.11	15.47	1.58	9.40	22.44
6	1.98	33.73	51.12	16.05	1.22	6.86	24.75
7	2.02	33.18	51.26	12.98	1.23	5.91	28.62
L.S.D. at 5%	1.16	1.70	2.24	1.16	0.91	1.34	2.29

* NPN= Non protein nitrogen. ** NSP= Non soluble protein.

Evaluation of lupine seeds during germination.

The observed reduction in protein with notable increment in albumins and globulins during the first three days of germination was due to the degradation of high molecular weight protein (NSP). As germination period advanced, non soluble protein was significantly increased and took place at the expence of albumins and globulins. Similar findings were obtained by Abdel-Hamid *et al.*., (1981).

Regarding the data in Table (4), desoxy ribose nucleic acid (DNA) showed gradual decrease reaching its minimum value at the fifth day of germination stage. This decrease reached 22.2% from the origin followed by further increment to reach its original amounts. Whereas, ribose nucleic acid (RNA) reflects opposite phenomena and increased by the rate of 43.3% for the same period of germination.

Table (4): DNA and RNA (mg P/g dry matter), trypsin inhibitor activity and total vicine (mg/g dry sample) of lupine seeds during germination.

Germination (days)	Mg P/g dry matter		Mg/g dry matter	
	DNA	RNA	TIA	Total vicine
0	0.27	0.30	1.58	5.0
1	0.27	0.30	2.11	4.3
2	0.22	0.36	2.11	3.3
3	0.22	0.41	2.63	3.1
4	0.27	0.42	3.16	2.8
5	0.21	0.43	2.11	2.5
6	0.27	0.42	1.18	2.4
7	0.28	0.43	1.05	2.4

The results indicate also that germination process affected both trypsin-inhibitor activity and total vicine content reaching their lowest amounts after 6 days of germination.

From the above mentioned results it could be concluded that germinating lupine seeds for 5-6 days before fertilization

improve their nutritional value by decreasing the amount of antinutritional factors such as trypsin-inhibitors and total vicine. Standal (1963) and Kasia *et al.*, (1966) showed similar findings in their studies on soybean proteins.

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Evaluation of lupine seeds during germination.

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التغيرات الكيماوية فى بذور الترمس أثناء الإنبات

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تمت دراسة التغير فى التركيب الكيماوى وبعض المواد الضارة غذائياً
فى بذور الترمس صنف (جيزة ١) يومياً أثناء مرحلة الإنبات ولمدة
٧ أيام .

وجد من الدراسة انخفاض معنوى تدريجى فى نسبة المادة الجافة ،
الكربوهيدرات الكلية ، الالياف الخام ، المواد الضارة غذائياً مثل مثبط
نشاط التربسين والفيسين الكلى خلال فترة الانبات ، هذا الانخفاض كان
مصحوباً بارتفاع معنوى لكل من الالبيومينات والجلوبيونات (المكونان
الرئيسيان للبروتين) ، الحامض النووى RNA والنروجين الذائب
الغير بروتينى ، والسكريات المختزلة والكلية .

تميزت بذور الترمس المنبتة لمدة ٥ - ٦ أيام بزيادة نسبية لبعض
المكونات الغذائية مثل الليبيدات ، البروتين الخام ، العناصر الغذائية
مقدرة كرماد ، السكريات الذائبة وانخفاض كمية المواد الضارة غذائياً
مثل الحامض النووى DNA ، مثبط انزيم التربسين ، الفيسيون
الكلى مما يؤدى الى زيادة القيمة الغذائية للبذور .