



## Physical and chemical evaluation of fatty oil and nutritional value of de-oiled cake of *Quercus leucotrichophora* (Banoak)

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### Abstract

*Quercus leucotrichophora* (Banoak) species have been evaluated for fatty oils and de-oiled cakes. The fatty oil content in the seeds of *Quercus leucotrichophora* was also evaluated for their physical and chemical characteristics. Oleic, palmitic and linoleic acids were found to be the major fatty acids in these oils. The de-oiled cakes of these species showed low protein contents (4.70%) and high starch contents (61.99%). The species can be tapped of its potentials for oil and oil cake utilizations. High starch content (61.99 %) suggest them as a good poultry feed.

**Keywords:** *Quercus leucotrichophora*, de-oiled cakes, fatty oil, evaluation, banoak and population

### Introduction

Many forest tree seeds are known to contain oils and fats. However, all have not been fully exploited due to difficulties in their collection. Proper exploitation of forest tree seeds can help in meeting the growing demand of oils and also opens avenues for utilization of de-oiled cakes for domestic, agricultural and industrial consumption. In Himachal Pradesh, though five *Quercus* species viz. *Quercus leucotrichophora*, *Q. dilatata*, *Q. semecarpifolia*, *Q. glauca* and *Q. ilex* are found but only three species namely, *Q. leucotrichophora*, *Q. dilatata*, and *Q. semecarpifolia* are found widely distributed. Among all, the *Quercus leucotrichophora* has major distribution and quite rich for its geographical adaptations. In the present studies, acorns of these three abundantly distributed species were taken to study qualitative and quantitative characters of their oils and de-oiled cakes.

### Materials and Methods

Fully matured acorns of *Q. leucotrichophora*, were collected from eight populations namely., Shilli, Chail, Taklech, Summer-Hill, Garsa, Manikaran, Sahu and Salooni in four districts namely., Solan, Shimla, Kullu and Chamba, respectively (Two site from one district) of Himachal Pradesh. At each site, composite sample of acorns made from five healthy trees.

The acorns were mechanically broken for separating the seeds. The oil was extracted with petroleum ether (40°-60°) in soxhlet extractor. The physical and chemical characteristics of oils were determined by standard methods [2].

The crude proteins in the de-oiled cakes were determined by Macro-Kjeldahl method [6]. Sugars of the samples were estimated by phenol-H<sub>2</sub>SO<sub>4</sub> method [3]. The residual cake was hydrolysed and glucose formed was determined by phenol-H<sub>2</sub>SO<sub>4</sub> method. The starch contents were calculated by multiplying the glucose values with 0.9 (a conversion factor). The data was analysed under factorial Randomised Block Design [5]. Fatty acid composition of oils was determined by saponification of oils followed by methylation of fatty acids and then subjecting the methyl esters of fatty acids to the gas liquid chromatography (GLC) Analysis on BSL-421 gas chromatograph using 3% SE-30 on WHF (Stainless steel 6' x 1/8") column, FID/ isothermal detector and by keeping column, injector and detector temperatures at 200° C, 220° C and 220° C, respectively.

### Results

Percents of seeds to acorns ratio ranged from 75.51 to 80.83. Maximum percentage of seeds to acorns ratio was found in populations S7 (Sahu) and minimum in S5 (Garsa). Percents of fatty oil content ranged from 11.54 to 12.56. Maximum percentage of seeds to acorns ratio was found in population S1 (Shilli) and minimum in S5 (Garsa). Specific gravity of seed oil was observed and results revealed non-significant results for different populations. Same value of 0.908 was observed for all the populations. Value of Refractive index of seeds oil showed non-significant result with value of 1.458. (Table 2).

Acid value of acorns ranged from 12.06 to 13.15. Maximum acid value was found in population S4 (Summer-Hill) and minimum in S5 (Garsa). Iodine Value acorns ranged from 76.58 to 80.38. Maximum value of Iodine was found in populations S8 (Salooni) and minimum in S1 (Shilli) Saponification value of acorns ranged

**Table 1:** Study Area with Elevation

S.No.	District	Area	Code	Elevation
1.	Solan	Shilly	S <sub>1</sub>	1480 m amsl
		Chail	S <sub>2</sub>	2250 m amsl
2.	Shimla	Taklech	S <sub>3</sub>	1350 m amsl
		Summer Hill	S <sub>4</sub>	2120 m amsl
3.	Kullu	Garsa	S <sub>5</sub>	1190 m amsl
		Manikaran	S <sub>6</sub>	1760 m amsl
4.	Chamba	Sahu	S <sub>7</sub>	1400 m amsl
		Salooni	S <sub>8</sub>	1850 m amsl

from 176.84 to 186.86. Maximum saponification was found in populations S4 (Summer-Hill) and minimum in S1 (Shilli). Unsaponifiable Matter value of acorns ranged from 0.690 to 0.779. Maximum value of unsaponifiable matter was found in population S4 (Summer-Hill) and minimum in S1 (Shilli). (Table 3).

Palmitic acid of acorns ranged from 14.0 to 21.2. Maximum value of palmitic acid was found in populations 1 (Shilli) and minimum in S6 (Manikaran). Oleic acid of acorns ranged from 73.3 to 80.08. Maximum value of oleic acid was found in population S1 (Shilli) and minimum in S6 (Manikaran). Linoleic acid to acorns ranged from 3.2 to 5.4. Maximum value of linoleic acid was found in population S8 (Salooni) and minimum in S3 (Taklech). Percents of Protein Content (%) of acorns ranged from 4.70 to 5.70. Maximum percentage Protein Content was found in population S7(Sahu) and minimum found in S1 (Shilli). (Table 4).

Percents of Starch Content (%) of acorns ranged from 55.67 to 61.99. Maximum percentage of starch content was found in population S8 (Salooni) and minimum in S2 (Chail). Percents of Soluble Sugar of acorns ranged from 1.59 to 1.71. Maximum percentage soluble sugar was found in population S8 (Salooni)

and minimum in S1(Shilli) simultaneously. (Table 5). Significant results observed among all populations. For traits Percentage of seeds to acorns palmitic acid oil protein content non enigmatical research obtain for all other rest traits percentage of seeds to acorns, fatty oil content, specific gravity of seed oil, Refractive index of seeds oil, acid value Iodine value, saponification value, unsaponifiable matter, starch content and soluble sugar.) Studied the seeds of *Pinus roxburghii* and reported variation in seed oil content and oil quality parameters [7]. Iodine value for *Quercus dilatata* (90.3), *Quercus ilex* (86-89) and *Quercus leucotrichophora* (81.5) which is in close proximity with the present investigation [1]. Significant variation noticed in protein contents of *Quercus leucotrichophora* seeds collected from different sites [8]. 4.72 per cent crude protein in *Quercus leucotrichophora*, which is in close proximity with the present investigation and also investigated variation in per cent nitrogen free extract of different *Quercus* spp [4]. On the basis of Index Scoring method Taklech (S3) and Salooni (S8) population ranked at number 1 and number 2, respectively, which reports more genetic diversity in natural populations of banoak in Himachal Pradesh.

**Table 2:** Evaluation of ban oak seeds oils for physical parameters

Population /Code	Percentage of seeds to acorns	Fatty oil content (%)	Specific gravity of seed oil	Refractive index of seeds oil
S1 (Shilli)	75.73	11.54	0.908	1.458
S2 (Chail)	79.72	11.62	0.908	1.458
S3 (Taklech)	78.98	12.51	0.908	1.458
S4 (Summer –Hill)	75.89	12.22	0.908	1.458
S5 (Garsa)	75.51	12.56	0.908	1.458
S6 (Manikaran)	78.84	12.28	0.908	1.458
S7 (Sahu)	80.83	12.09	0.908	1.458
S8 (Salooni)	79.68	12.24	0.908	1.458
C.D(0.05)	2.07	NS	NS	NS

**Table 3:** Evaluation of ban oak seeds oils for chemicals parameters

Population /Code	Acid value	Iodine value	Saponification value	Unsaponifiable matter
S1 (Shilli)	12.66	76.58	182.15	0.709
S2 (Chail)	12.44	78.46	182.63	0.688
S3 (Taklech)	12.51	79.10	183.92	0.717
S4 (Summer –Hill)	13.15	79.59	186.86	0.737
S5 (Garsa)	12.06	78.19	182.64	0.779
S6 (Manikaran)	12.70	79.04	181.65	0.728
S7 (Sahu)	12.93	80.13	176.84	0.702
S8 (Salooni)	12.62	80.38	184.16	0.69
C D (0.5)	NS	NS	NS	NS

**Table 4:** Fatty acid Composition (%) of *Quercus* ban oak seeds oils

Population/Code	Palmitic acid	Oleic acid	Linoleic acid.
S1 (Shilli)	21.2	73.3	4.6
S2 (Chail)	20.7	74.5	3.3
S3 (Taklech)	18.4	76.7	3.2
S4 (Summer –Hill)	14.5	82.4	3.2
S5 (Garsa)	15.5	80.5	3.9
S6 (Manikaran)	14.0	80.8	4.8
S7 (Sahu)	16.6	79.5	4.0
S8 (Salooni)	18.3	75.4	5.4
C D (0.5%)	0.57	3.11	N.S

**Table 5:** Evaluation of de-oiled seeds cakes of ban oak

Population/Code	Protein content (%)	Starch content (%)	Soluble sugar (%)
S1 (Shilli)	4.70	57.65	1.59
S2 (Chail)	5.19	55.67	1.63
S3 (Taklech)	5.03	60.00	1.67
S4 (Summer –Hill)	5.43	58.68	1.68
S5 (Garsa)	5.47	58.56	1.68
S6 (Manikaran)	5.51	58.65	1.65
S7 (Sahu)	5.70	60.43	1.67
S8 (Salooni)	5.63	61.99	1.71
C D (0.5%)	0.44	NS	NS

## Conclusion

Thought the oil content in the seeds of the seeds of *Quercus leucotrichophora* is less, but considering its wide distribution in Himachal Pradesh, this species can be tapped for oil and oil cake utilization. The moderate iodine value suggest that oil of the species can be suitable for soap preparations but not for paint and varnishes. Though, the non saponifiable matter is low, and low but high acid value to make them suitable for edible for purposes. Thought, protein content as well as soluble sugar contents are low, but high starch contents in the cake suggest them as good poultry feed. High content also suggests that acorns can also be

used for preparation of industrial alcohol (Ethyl alcohol) through formation. High acid value demand that these fatty oils should be refined to sufficiently reduce acid value to finally make them suitable for edible purposes. Moderate iodine value suggests that oils of this species can be suitable for edible purposes as well as for soap preparation, but not for paints and varnishes.

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