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THE EFFECT OF PLANT AGE ON NUTRIENT COMPOSITION OF *QUERCUS SEMECARPIFOLIA* COLLECTED FROM DISTRICT MANDI OF HIMACHAL PRADESH INDIA

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ABSTRACT

Quercus semecarpifolia leaves were collected from district Mandi in June, 2017 for assessment of nutritive composition. For analyses of fodder quality leaves were collected from different aged (mature, middle and juvenile) trees based on diameter at breast height (DBH at 1.3 m). The DBH of studied mature trees was more than 40 cm and for middle aged trees it varied from 20 – 40 cm and for juvenile trees it was less than 20 cm. Results showed that mature plant leaves showed highest percentage of CF, CP, NDF and ADF while juvenile tree leaves showed minimum percentage of crude protein, crude fiber, acid detergent fiber and neutral detergent fiber. It was also observed that there is no such effect of plant age or plant maturity on ether extract content of leaves. So the mature leaves of *Q. semecarpifolia* harvested offers considerable potential as high quality forage for livestock to fulfill the deficiency of protein and nutrients.
Keywords: *Himachal Pradesh*, *Nutrient composition*, *plant age*, *Quercus semecarpifolia.*

Introduction

Plant nutrients are the chemical components that are important to the nutrition of plant strength (Jardin, 2015). Plant nutrients drop into three groups and that groups were based on the quantity of plant required. All plant nutrients do vital characters in plant evolution and progress. Tree and shrub leaves are significant component of small ruminant diets in several portions of the world and play a vital role in nutrition of browsing animals in areas where insufficient or no replacements are available (Gxasheka *et al*., 2015). Nutrient contents are impartially high in all fodder tree species though, their quantity varies markedly from one species to alternative (Nautiyal *et al*., 2017). Dissimilarities in nutrient contents in an individual species also occur with the alteration in season. Around one hundred tree species changing significantly in their superiority, palatability and inclinations to the agriculturalists are being recycled for this purpose (Berhanu *et al*., 2019). The accessibility of cultured green fodder has reduced due to decrease in cultivatable area for forage manufacture (Kumar *et al*., 2018).

Presently, farmers are concentrating only on money crops in its place of fodder or forage production due to less earning yield. This decline results in low quantity and quality of fodders, which is accountable for poor cattle making (Nouman *et al*., 2014). Leaf protein bases attained in leaf vegetables, legume trees, forage trees and shrubs as feed resources to entirely classes of cattle offer incredible abilities and conventional cumulative consideration (Zayed *et al*., 2014). In India there are more than 35 species of oaks were occur while in case of West Himalaya, total 5 species of evergreen oaks, namely *Quercus leucotrichophora* (local common name: banj), *Q. glauca* (phaliyant), *Q. lanata* subsp. *lanata* (syn. *Q. lanuginosa*) (rianj), *Q. floribunda* (tilonj), and *Q. semecarpifolia* (kharsu), cultivate unsurprisingly in northern India of Kumaun region of. *Quercus semecarpifolia* forms extensive forests at higher elevations (2,500–3,300 m) which represents the climax community and commonly known as brown oak. *Q. semecarpifolia* is a multipurpose tree used to provide fuelwood, fodder, agriculture implements and tannin (Joshi and Anderson, 2020). The species is also considered to be one of the oldest plants in the region which has been over exploited for centuries in the Himalaya (Shekhar *et al*., 2021). Thus, the aim of present investigation was to review the effect of juvenile tree leaves and mature tree leaves on nutritional values of *Quercus semecarpifolia* leaves.

Materials and Methods

Sample collection

To assess the nutrient composition changes in different age groups of *Q. semecarpifolia* leaves, foliage was harvested from district Mandi. Leaf samples were collected in the month of June 2017. Randomly leaves were collected from all parts of the tree, to make composite sample. Collected leaves were sun dried and crushed in mechanical grinder to obtain fine powder for determination of the nutritional changes in *Q. semecarpifolia* leaves.

Nutritional analysis

Determination of ether extract

Ether extract was determined by following the method of (AOAC, 1995). 5 g oven dried leaf extract was estimated with the assistance of Soxhlet's apparatus and placed in an extractor. The extractor was connected with pre weighted flask below and condenser above, followed by 60 ml petroleum ether. Cold water was well-versed the condenser during the extraction process and the extraction was applied for six hours till the liquid was as clear as clean water, flask was then disconnected and dried in hot air oven for 4-6 hours. After cooling it, weighed to a relentless weight. The difference within the weight of flask after and before extraction denoted the ether extract of the sample.

$$\text{Ether extract }\% = \frac{w_2 - w_1}{w} \times 100$$

Determination of crude fiber

Crude fiber content was determined by following the method of (AOAC, 1995). In 2 g leaf extract 100 ml of 1.25% sulphuric acid solutions was added, boiling for 30 min, then filtered. The obtaining residue was then rinsed fourfold with boiling water with repetition on the residue using 100 ml of 1.25% NaOH solution. Residue was then dried in oven at 100 °C. Cooled in an exceedingly desiccator and weighed (C1), then reduced it to ashes in an exceedingly muffle furnace at 550 °C for five hours and reweighed (C2).

$$\text{Crude fiber }\% = \frac{C_2 - C_1}{\text{Weight of original sample}} \times 100$$

Determination of acid detergent fiber

Acid detergent fiber was estimated by following the method of (Goering and Soet, 1970). In 1 litre H_2SO_4 dissolved 20 g of CTAB and prepared acid detergent solution. In 1 g of leaf extract 100 ml acid detergent solution was added followed by 2 ml of decalin. After refluxing, the residue was filtered through pre-weighed sintered glass crucible which is washed with warm water 2-3 times followed by acetone to get rid of all salts. Residue was then dried in hot air oven and reweighed.

$$\text{ADF }(\%) = \frac{\text{(Weight of crucible with residue – Weight of empty crucible}}{\text{Weight of sample taken}} \times 100$$

Determination of neutral detergent fiber

Neutral detergent fiber was estimated by following the method of (Goering and Soet, 1970). In 100 ml of H_2O, 18.61 g EDTA and 6.81 g of sodium borate dehydrate was added with constant heating on hot plate until dissolved. In another beaker 30 g sodium lauryl sulphate and 10 ml of 2-ethoxy ethanol was added in 90 ml water and combine this mixture to the previous solution to prepare neutral detergent solution. In 2 g leaf extract 100 ml of preheated neutral detergent solution was added followed by 0.5g sodium sulphite and decalin and refluxed for an hour after the initial onset of boiling. Then washed it frequently with boiling water to get rid of all salts. Then residue was dried in hot air oven over night at 100±5°C, after cooling weighed it and put it in a muffle furnace at 550 °C for 2-3 h and reweighed.

$$\text{NDF }(\%) = \frac{\text{(Weight of crucible with cell well constituents) – (Weight of crucible)}}{\text{Weight of sample taken}} \times 100$$

Determination of crude protein

Crude protein content was determined by following the method of (Unuofin *et al*., 2017). 2 g leaf extract was added to 20 ml of concentrated H_2SO_4, digested within a Kjeldahl flask until the mixture is vibrant. The digest was then filtered and made 250 ml volume with distilled water. In aliquot 50 ml of 45% sodium hydroxide solution was added. In 150 ml of the distillate 100 ml of 0.1 N Hcl was added and titrated it against 2.0 mol/L NaOH using methyl orange indicator. The end point was indicated by a color change to yellow.

Results and Discussion

Present study showed that ether extract percentage varied from 2.01% to 2.56% (Table 1). The lowest percentage of ether extract (2.01%) was observed in juvenile tree leaves and highest percentage of ether extract i.e. 2.56% was observed in mature tree leaves. There is no effect of ether extract on plant maturity. There is slight variation in mean percentage of ether extract but statistically data showed non-significant variation (P>0.05) with respect to plant age (Figure 1 'A').Previous research reveals that ether extract varies widely with species. In *Albizzia chinensis* 34.73% ether extract was reported during January month (Okunade *et al*., 2014). Average 9.0% ether extract was reported in *Acacia nilotica* spp (Gaikwad *et al*., 2017) and 4.79 %ether extract in leaves and shrubs of scarcity zone of Maharashtra. Jowarkadbi, soybean straw, hybrid napier (green fodder) and concentrate (sugras dry ration) were reported to contain 2.84%, 2.51%, 2.50% and 5.27% ether extract content respectively (Sonane *et al*., 2018). While in case of crude protein the percentage varied from 5.635 to 14.35%. Data showed that lowest percentage of crude protein i.e. 5.63% was observed in juvenile age tree leaves and it increases with the plant maturity. Middle age tree leaves showed highest % of crude protein i.e. 14.35%. Same as ether extract, statistically crude protein showed non-significant variation (P>0.05) with respect to plant age (Figure 1 'A'). 3.74%, 6.13%, 5.77% and 17.34% crude protein content in Jowarkadbi, soybean straw, hybrid Napier (green fodder) and concentrate (sugras dry ration) and (Sonane *et al*., 2018) 14.56% in hydroponic maize fodder (Kide, 2015) were observed. Crude proteins were reported 13.59% in *Ficus carica* and 13.38% in *Triticum aestivum* (Khan *et al*., 2014).

In present study crude fiber percentage varied from 20.75% to 41.93%. The lowest percentage of crude fiber (20.75%) was observed in juvenile tree leaves and highest percentage of crude fiber i.e. 41.93% was observed in mature tree leaves. So it is clear from the data that as the plant get matured the percentage of crude fiber increases. Juvenile age tree vs. middle age tree showed P<0.05 level of significant variation whereas, juvenile age tree vs. mature age tree showed highly significant variation (P<0.001) while, middle age tree vs. mature age tree showed significant (P<0.05) variation (Figure 1 'B'). Previous study on crude fiber content of plant leaves revealed a wide variation. In Jowarkadbi, soybean straw, hybrid Napier (green fodder) and concentrate (sugras dry ration) 32.48%, 44.21%, 26.28% and 11.84% crude fiber content were reported (Sonane *et al*., 2018). It was observed that *Thysanolaena maxima* contain 23.74% to 33.17% crude fiber (Shah *et al*., 2019). Crude fiber ranges between 32.01 to 35.99% in highest rainfall received fodder varieties in Wayanad district, Kerala (Murugan *et al*., 2016). In leguminous tree leaves 17.81 to 28.16% crude fiber was observed (Paramasivam, 2018).

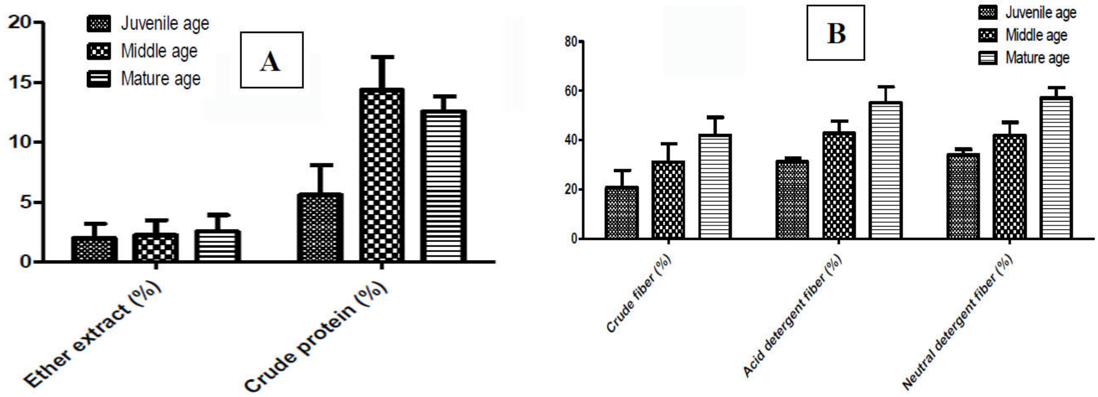

Fig. 1 : 'A': Ether extract (%), Crude protein (%); 'B': Crude fiber (%),Acid detergent fiber (%), Neutral detergent fiber (%)of district Mandi; values were analysed by one-way ANOVA followed by Bonferroni's Multiple Comparison Test.

Acid detergent fiber and neutral detergent fiber percentage varied from 31.15 to 55.16% and 33.96 to 57.02%. The lowest percentage of acid detergent fiber and neutral detergent fiber 31.15% and 33.96% was observed in juvenile tree leaves while mature tree leaves reported with highest percentage i.e. 55.16% and 57.02%. In Acid detergent fiber Juvenile age tree vs. middle age tree showed $p<0.05$ level of variation whereas, juvenile age tree vs. mature age tree showed highly significant variation ($P<0.001$) while, middle age tree vs. mature age tree showed also showed significant variation with $p<0.05$ level. In neutral detergent fiber juvenile age tree vs. middle age tree showed non-significant variation ($P>0.05$), juvenile tree vs mature age tree showed highly significant variation ($P<0.001$) and middle age tree vs. mature age tree showed $P<0.01$ level of significant variation (Figure 1 'B'). Acid detergent fibre content and neutral detergent fiber of tree leaves of present study finds support from the work done by other workers in the past. Hashmi and Waqar (2014) also reported ADF content were increase from summer to spring in *Grewia populifolia*. In baby corn genotype 40.80% ADF and 64.13% NDF were reported (Chaudhary *et al.*, 2013). In *Thysanolaena maxima* 35.68% to 45.91% ADF content and 52.73% to 79.22% NDF were reported (Shah *et al.*, 2019; Murugan *et al.*, 2016). It was observed that ADF content ranges between 31.33%-41.27% and NDF ranges between 60.84%-77.10% in highest rainfall received fodder varieties in Wayanad district, Kerala. (Paramasivam, 2018) 36.30% to 56.13% NDF was reported in leguminous tree leaves and in green fodder of maize 24.2% ADF was reported (Htet *et al.*, 2021).

Conclusion

The study showed that a nutritive value of *Quercus semecarpifolia* leaves was significantly influenced by altitude and season. Harvesting stage was an important factor affecting nutritive value of *Q. semecarpifolia* leaves. Data showed that there is no such effect of plant age on ether extract. While in case of crude protein, crude fiber, acid detergent fiber and neutral detergent fiber the percentage were increases with the plant maturity. So the mature leaves of *Q. semecarpifolia* harvested offers considerable potential as high quality forage for livestock to fulfill the deficiency of protein and nutrients.

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