Assessment of physico-chemical composition of Castor beanan indigenous medicinal shrub of Khyber Pakhtunkhwa

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ABSTRACT

The samples (leaves) were collected from *Ricinuscommunis*found at their natural habitat of Khanpur Valley in the sub Himalayan Mountains of Pakistan and chemical analysis was carried out at the University of Agriculture Peshawar. Significant effects were observed at different seasons and sites upon various bio-chemical substances. *Ricinuscommunis*revealed higher significant values for crude proteins (15.26%) at Mang during summer, crude fibers (13.85%) at Dabola during winter, crude fats (10.24%) at Jabri during summer, essential oil (3.48%) at Mang during winter, NFEE (195.29%) at Jabri during summer, sodium (4.91mg/100g) at Dam during summer, iron (300.37mg/100g) at Jabri during summer, manganese (13.43mg/100g) at Dabola during summer and zinc (8.07mg/100g) at Mang during summer. *Ricinuscommunis*showed maximum bio-chemicals in the samples collected during last week of July.

Key words:*Ricinuscommunis; Himalayan Mountains; Khanpur Valley; bio-chemical; natural habitat*

I. INTRODUCTION

The castor bean (Ricinuscommunis), a drought-resistant plant in the Euphorbiaceae family, is an essential food source. Pakistan, China, the United States, Brazil, the former Soviet Union, and Thailand are major producers of castor bean (Asif et al., 2017). Depending on their size and number of seeds, plants can be classified as shrubs and trees or as annual herbs (Mehmoodet al., 2018). Because of its numerous applications in industry and medicine, the castor bean (Ricinuscommunis L.) is a highly valuable oilseed shrub with enormous economic significance (Galal et al., 2021).

Almost all of the plant's components, Ricinuscommunis, are beneficial. (Franke et al., 2019). Some important activities are: anti-inflammatory (Hussain et al., 2021; Abdul et al., 2018; Mehmood et al., 2022), insecticidal (Rehman et al., 2022; Sotelo-Leyva et al., 2020), memory enhancing (Vasconcelos et al., 2017; Neto et al., 2018), purgative (Shobha et al., 2019; Taran et al., 2022), protection against carbon tetrachloride and galactosamine induced hepatic damage (Babu et al., 2017; Czekaj et al., 2019), diuretic (Khan et al., 2022; Vinodoni et al., 2018), antineoplastic (Díaz et al., 2018; Mannucci et al., 2021), anti HIV (Kibonde et al., 2018; Elkousy et al., 2021), abortifacient, galactogogue and lactogogue, in abscess and sores, in enlarged liver and spleen, in asthma, hemorrhoids and various female problems (Ganesan and Xu, 2017; Prasad et al., 2019).

Additionally, the seeds contain approximately 25 percent protein, 10-20 percent carbohydrates, 2.2 percent ash, and 5.1-6.5 percent moisture (Mehmood et al., 2021). Over 95% of the world's castor farming occurs in India, China, and Brazil (Ayub et al., 2021). Castor beans are significant due to the peculiar composition of its oil, which is high in the hydroxyl fatty acid, ricin oleic acid (80–85 percent). Castor oil was formerly utilisedmostly for therapeutic purposes (Ayub et al., 2021: Tian et al., 2019). Historically, it has been harvested for its oil, which has been used in cosmetics (Mehmood et al., 2021), shampoo, soap, hand lotion, laxatives, lamp fuel, and high-speed lubricants, among other things, from the beginning of time (Shah et al., 2021: Behr and Seidensticker, 2020).

Recent research efforts have been directed to identify and evaluate certain alternative/additional proximate composition and essential oil source for the future world. However, before recommending such non-conventional foodstuff, their compositional and nutritional properties should be thoroughly investigated.

II. MATERIAL AND METHODS

Impact of different seasons and sites on nutritional Chemical constituents of *Ricinuscommunis*an indigenous medicinal shrub of Khyber Pakhtunkhwa was conducted during 2012-2013. Mature leaves of *Ricinuscommunis* were collected from their natural habitat at all the four sites and two seasons. Plant material were collected in summer during last week of July and in winter during last week of December.

Through quadrate transact method, three transacts (replications) were taken in every transact, the materials were collected from different available plants and fresh weights were recorded. The samples were brought to the laboratory of the Agricultural Chemistry, The University of Agriculture Peshawar. The sample was thoroughly cleaned manually and then made into powder by laboratory grinder. The samples in the grinded form were then analyzed for the following bio-chemical attributes, using standard procedures:

RESULTS

I. Proximate Analysis:

Table-1. Effect of Different Seasons and Sites on Proximate Analysis of *Ricinuscommunis*, indigenous to Khanpur Valley, in sub-Himalayan mountains of Pakistan.

Seasons	Moisture %	Dry Matter%	Ash/minerals%	Crude Proteins %	Crude Fibers%	Fats%	Essential Oils%	NFES%	NFEE
Summer	74.52	25.47	16.97a	14.13a	9.82b	9.63	2.17	49.45	189.74
Winter	69.23	30.82	14.47b	12.20b	12.26a	7.82	2.76	53.25	170.09
LSD at α 0.05	1.958	1.958	1.117	0.385	0.548	0.265	0.206	1.160	1.892
Sites									
Dam	73.90	26.19	16.39a	12.64	9.36c	8.63	1.58d	52.97a	178.63
Dabola	71.46	28.54	15.16b	12.77	12.53a	9.13	2.12c	50.41b	180.92
Jabri	71.67	28.33	17.11a	13.68	10.84b	9.10	2.69b	49.27b	183.19
Mang	70.48	29.52	14.24c	13.58	11.41b	8.03	3.47a	52.74a	176.95
LSD at α 0.05	Ns	ns	0.750	ns	0.947	ns	0.499	1.399	ns
Interactions									
Seasons*Sites	Ns	ns	ns	*	*	*	*	ns	*

II. Means followed by similar letter(s) in column do not differ significantly.

III. ns = Non Significant.

IV. * = Significant at 5 % level of probability.

A. Moisture%:

The mean data of moisture % for various seasons and sites is shown in Table-1. The results revealed that the effect of seasons on moisture % was significant while the effect of sites and their interactions was non-significant. Maximum moisture % was observed at summer (74.52%) while minimum at winter (69.23%).

B. Dry Matter %:

The mean data of dry matter % for various seasons and sites is shown in Table-**1**. The results revealed that the effect of seasons on dry matter % was significant while the effect of sites and their interactions was non-significant. Maximum dry matter % was observed at winter (30.82%) while minimum at summer (25.47%).

C. Ash / Minerals %:

The mean data of ash / minerals % for various seasons and sites is shown in Table-**1**. The results revealed that the effect of seasons and sites on ash / minerals % was significant while a non-significant effect was observed for interactions on ash/minerals %. Maximum ash / minerals % was observed at summer (16.97%) while minimum at winter (14.47%). Similarly maximum ash / minerals % was recorded at Jabri site (17.11%) while minimum at Mang site (14.24%).

D. Crude Proteins %:

The mean data of crude proteins % for various seasons and sites is shown in Table-**1**, while their interaction is shown in Figure-1. The results revealed that the effect of seasons and their interactions on crude proteins % was significant while that of sites was non-significant. Maximum crude proteins % was observed at summer (**14.13**%) while minimum at winter (12.20%). In case of interactions maximum crude proteins % was recorded at Jabri site during summer (**13.68** %) followed by Mang site during summer (**13.58**%) while minimum of it was observed at Dam site during winter (**12.64** %).

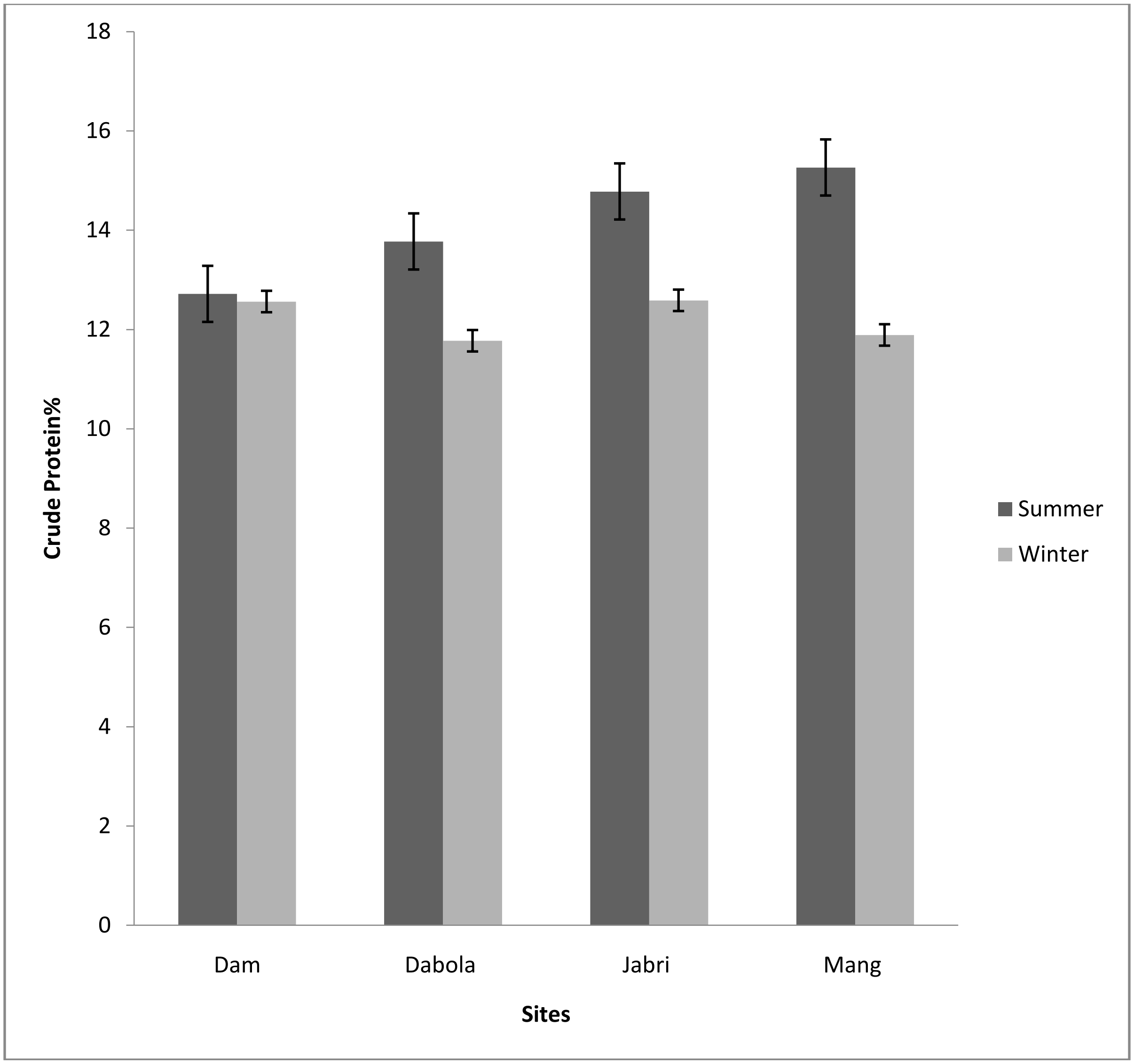

Figure-1: Effect of different seasons and sites on Crude Protein contents in leaves of *Recinuscommunis*.

E. Crude Fibers %:

The mean data of crude fibers % for various seasons and sites is shown in Table-1, while their interaction is shown in Figure-2. The results revealed that the effect of seasons, sites and their interactions on crude fibers % was significant.

Maximum crude fibers % was observed at winter (12.26%) while minimum at summer (9.82%). Similarly maximum crude fibers % was recorded at Dabola site (12.53%) while minimum at Dam site (9.36%). In case of interactions maximum crude fibers % was recorded at

Dabola site during winter (13.85%) followed by Mang site during winter (13.57%) while minimum of it was observed at Mang site during summer (9.26%).

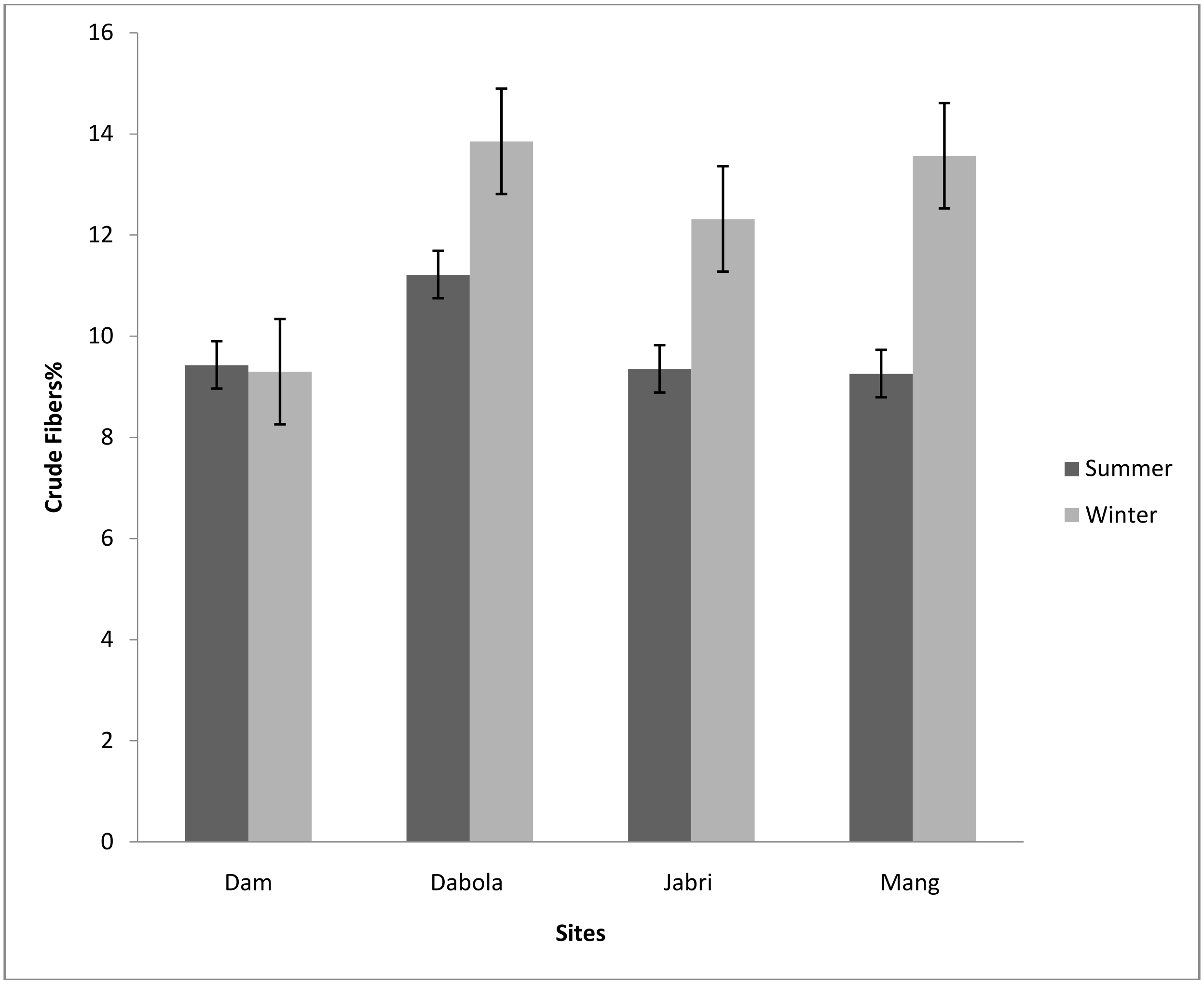

Figure-2: Effect of different seasons and sites on Crude Fibers contents in leaves of *Recinuscommunis*.

F. Crude Fats %:

The mean data of crude fats % for various seasons and sites is shown in Table-1, while their interaction is shown in Figure-3. The results revealed that the effect of seasons and their interactions on crude fats % was significant while that of sites was non-significant.

Maximum crude fats % was observed at summer (9.63%) while minimum at winter (7.82%). In case of interactions maximum crude fats % was recorded at Jabri site during summer

(10.24%) followed by Dam site during summer (9.79%) while minimum of it was observed at Mang site during winter (7.35%).

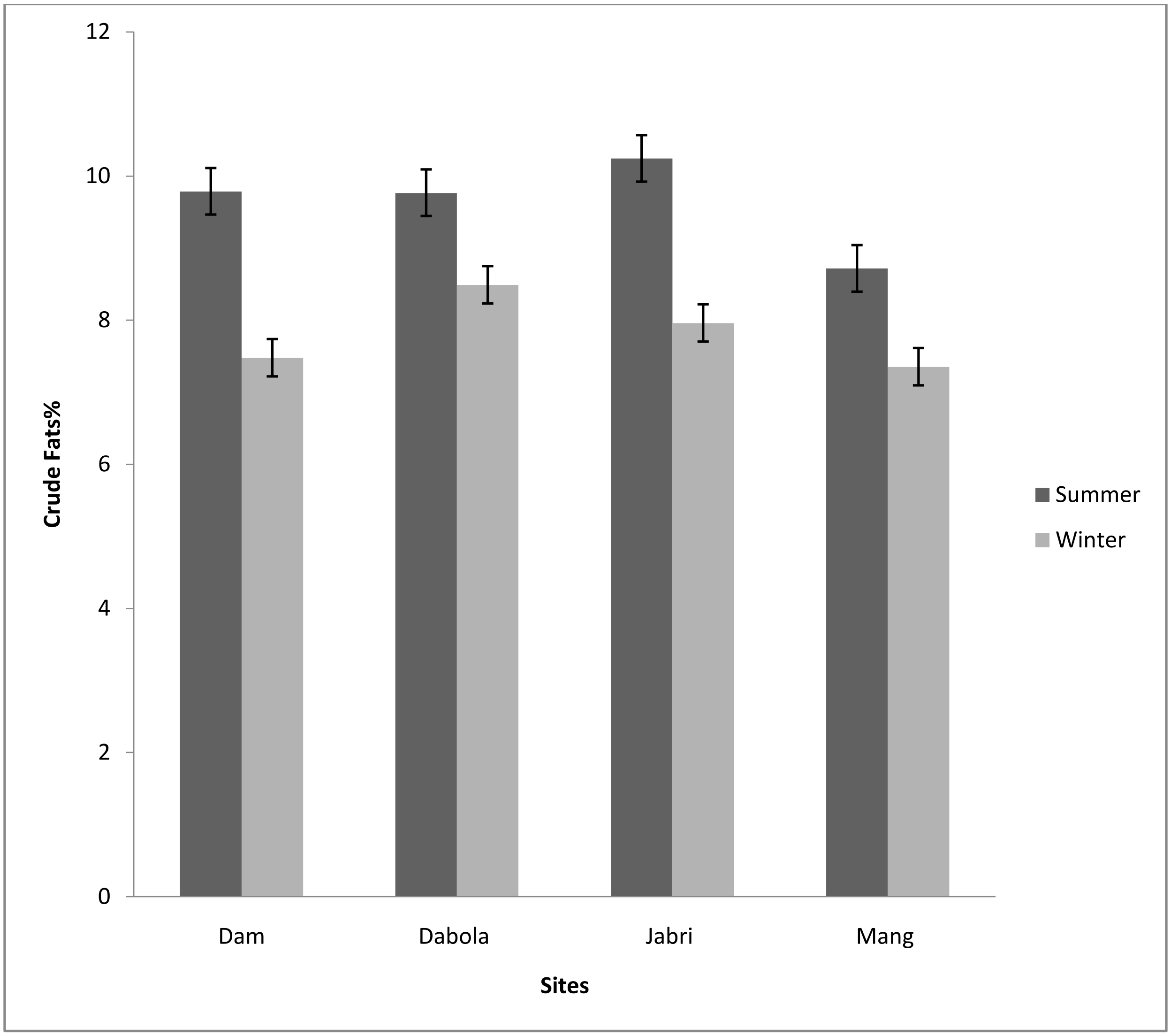

Figure-3: Effect of different seasons and sites on Crude Fats contents in leaves of *Recinuscommunis*.

G. Essential Oils%:

The mean data of essential oil % for various seasons and sites is shown in Table-1, while their interaction is shown in Figure-4. The results revealed that the effect of seasons, sites and their interactions on essential oil % was significant.

Maximum essential oil % was observed at winter (2.76%) while minimum at summer (2.17%). Similarly maximum essential oil % was recorded at Mang site (3.47%) while minimum at Dam site (1.58%). In case of interactions maximum essential oil % was recorded at Mang site during winter (3.48%) followed by Mang site during winter (3.47%) while minimum of it was observed at Dam site during summer (1.52%).

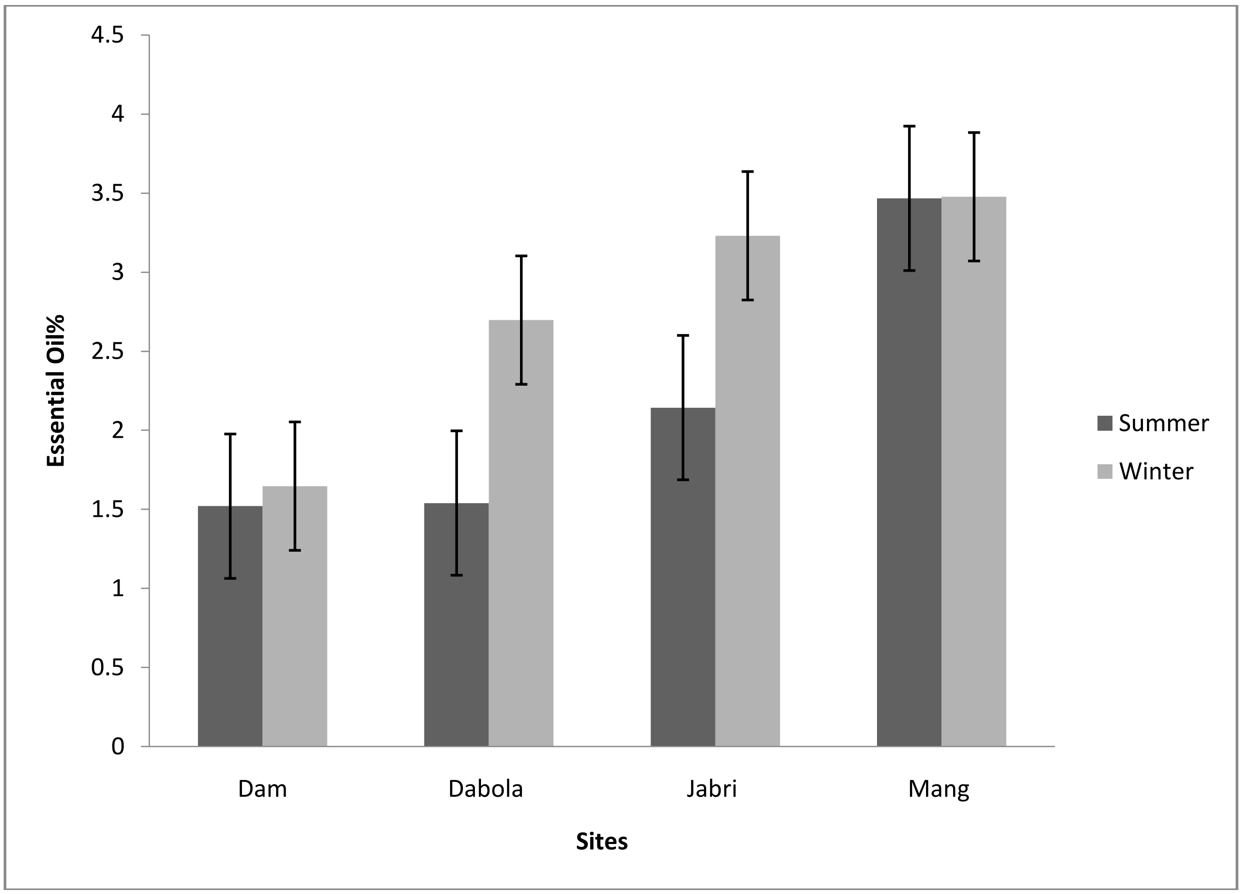

Figure-4: Effect of different seasons and sites on Essential Oil contents in leaves of *Recinuscommunis*.

***H.* Nitrogen Free Extractable Substances (NFES) %:**

The mean data of NFES % for various seasons and sites is shown in Table-1. The results revealed that the effect of seasons and sites on NFES was significant while that of their interactions was non-significant.

Maximum NFES % was observed at winter (53.25%) while minimum at summer (49.45%). Similarly maximum NFES % was recorded at Dam site (52.97%) while minimum at Jabri site (49.27%).

I. Net Free Energy Estimation (NFEE):

The mean data of NFEE for various seasons and sites is shown in Table-1, while their interaction is shown in Figure-5. The results revealed that the effect of seasons and their interactions on NFEE % was significant while that of sites was non-significant.

Maximum NFEE was observed at summer (189.74) while minimum at winter (170.09). In case of interactions maximum NFEE was recorded at Jabri site during summer (195.29) followed by Dabola site during summer (189.04) while minimum of it was observed at Mang site during winter (166.31).

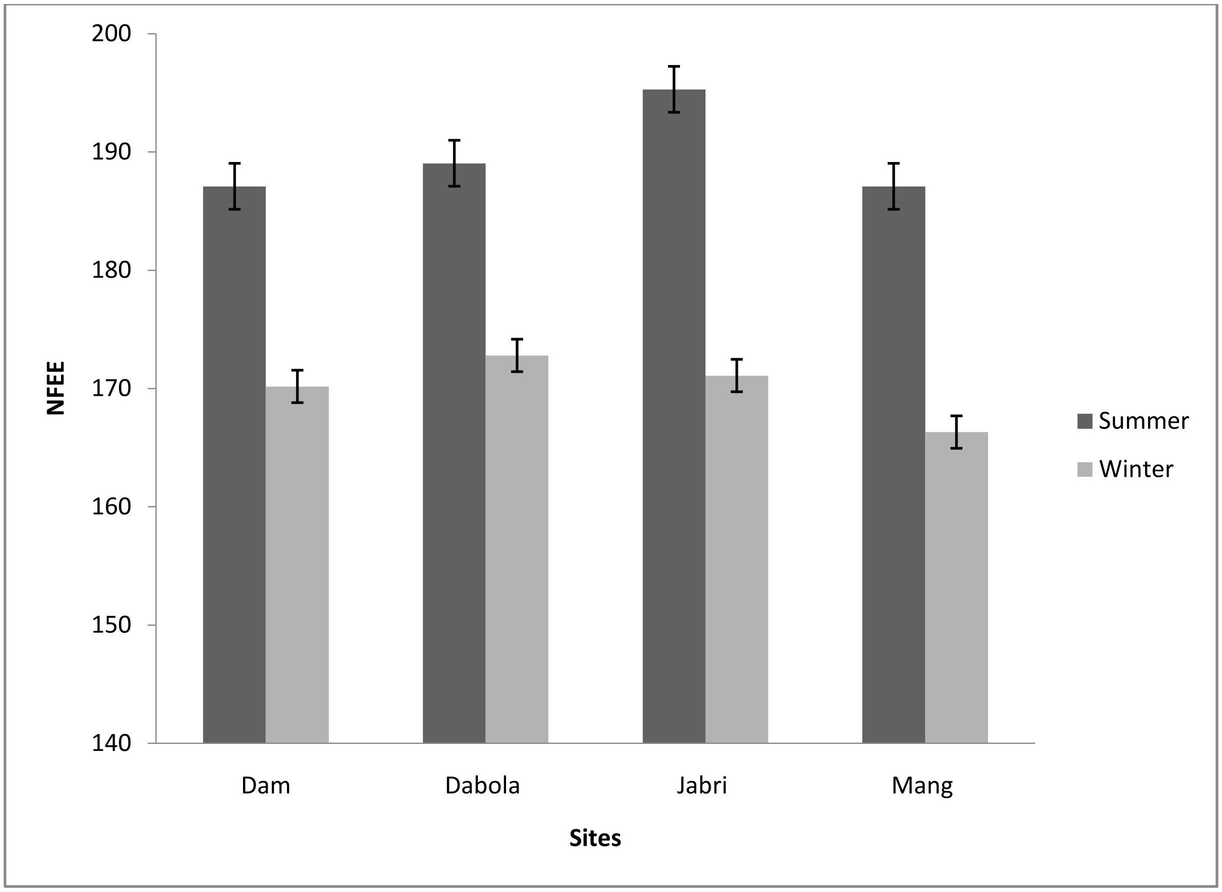

Figure-5: Effect of different seasons and sites on NFEE in leaves of *Recinuscommunis*.

It is evident from the results that summer and winter seasons have significantly affected the bio-chemical attributes. The bio-chemical compounds like moisture, ashes, crude proteins, crude fats and NFEE were higher in summer season than winter season in the leaves of wild Jatropa. In Ricinuscommunis, which is an evergreen shrub, the plant accumulated maximum bio-chemical compounds in summer to grow at higher rate and to keep nutrients for winter stresses. Summer rains and high water availability to plants facilitated the accumulation of these compounds in leaves during summer. These results were confirmed by many reports (Shahzad et al., 2021: Ahmad et al., 2013; Glivin et al., 2021).

On the other hand dry matter, crude fibers, essential oils and nitrogen free extracts were found significantly higher during winter than summer in all of the sites. The accumulation of these compounds may be due to low temperature and deficiency of water and stresses (Ayub et al., 2020: Ahmad et al., 2017; Vilanova et al., 2018). Furthermore, plants grown in cold areas accumulate oils and sugar during early winter to cope with severe cold and provide support to plant survival and protect it from frost injury (Khan et al., 2020: Castonguay et al., 2006; Ghassemi et al., 2021).

The sites comparison revealed that majority of the parameters were not significantly affected by sites and only ashes, crude fibers, essential oils and NFES were significantly varied among sites. Jabri site showed maximum results for essential oils and ashes while Dabola site gave maximum crude fiber which might be associated with environmental stresses as both the sites are at higher altitude and the plant prefer low plains (Mehmood et al., 2020: Chauhan et al., 2014; Dagar et al., 2014). Highest value of NFES at Dam site

III. Elementology:

Table-2. Effect of Different Seasons and Sites on Elemental analysis of *Ricinuscommunis*, indigenous to Khanpur Valley, in sub-Himalayan mountains of Pakistan.

Seasons	Sodium (Na)	Potassium (K)	Calcium (Ca)	Phosphorus (P)	Magnesium(Mg)	Copper (Cu)	Iron (Fe)	Manganese(Mn)	Zinc (Zn)
Summer	2.55a	83.67a	105.79a	135.72b	264.20b	0.62a	260.12a	12.41a	6.50a
Winter	1.37b	70.17b	84.17b	171.72a	284.25a	0.37b	208.25b	8.70b	3.67b
LSD at α 0.05	0.215	13.457	20.594	15.957	ns	0.061	15.129	0.813	0.555
Sites									
Dam	3.07a	96.08a	71.42c	147.62	294.17a	0.39b	219.73bc	12.33a	4.68b
Dabola	1.61b	60.25b	122.57a	170.33	282.98a	0.57a	240.33b	10.35b	4.65c
Jabri	1.74b	57.25b	82.87bc	159.03	283.07a	0.57a	279.08a	9.78b	3.89c
Mang	1.41b	94.08a	103.08ab	137.35	236.68b	0.45b	197.58c	9.75b	7.15a
LSD at α 0.05	0.775	16.963	30.282	Ns	28.111	0.067	30.735	1.130	0.791
Interactions									
Seasons*Sites	*	ns	Ns	ns	ns	ns	*	*	*

Means followed by similar letter(s) in column do not differ significantly.

ns = Non Significant.

* = Significant at 5 % level of probability.

1. Sodium (Na) mg/100g:

The mean data of Na for various seasons and sites is shown in Table-**2**, while their interaction is shown in Figure-6. The results revealed that the effect of seasons, sites and their interaction on P was significant.

Maximum Na was observed at summer (1.55 mg/100g) while minimum at winter (1.37 mg/100g). Similarly maximum Na was recorded at Dam site (3.07 mg/100g) while minimum at Mang site (1.41 mg/100g). In case of interactions maximum Na was observed at Dam site during summer (4.91 mg/100g) followed by Jabri site during summer (2.22 mg/100g). While minimum Na was observed at Dam site during winter (1.22 mg/100g).

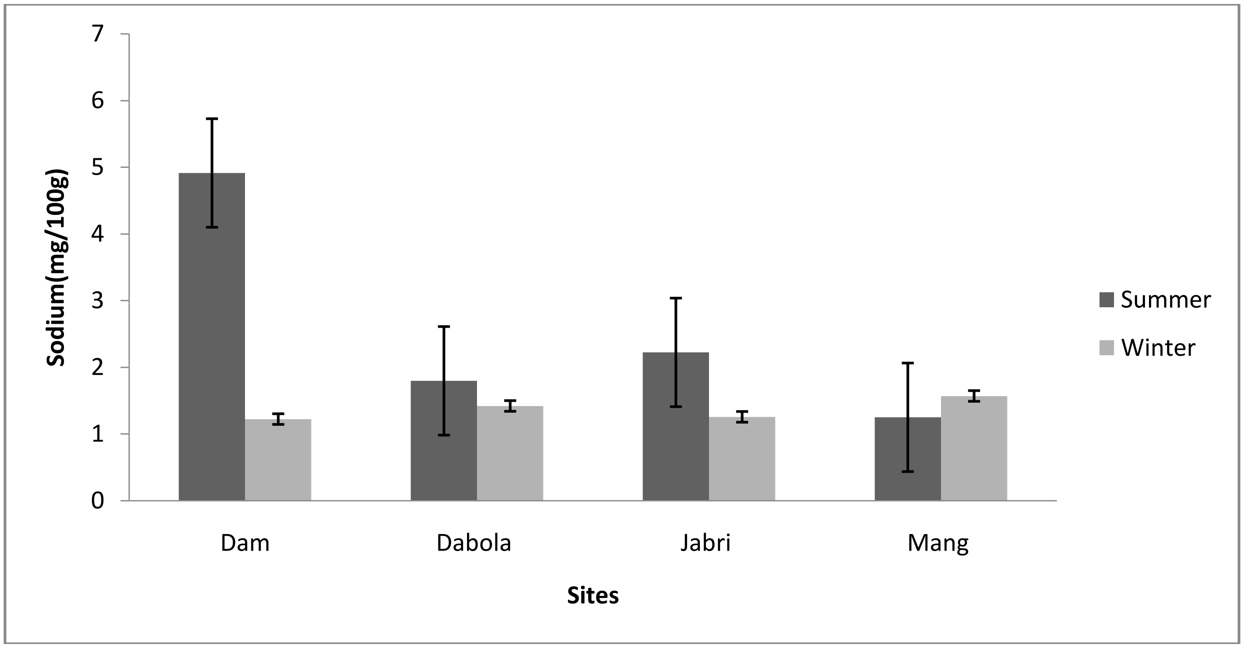

Figure-6: Effect of different seasons and sites on Sodium content in leaves of *Ricinuscommunis*.

J. Potassium (K) mg/100g:

The mean data of K for various seasons and sites is shown in Table-2. The results revealed that the effect of seasons and sites on K was significant while the effect of their interaction was non-significant.

Maximum K was observed at summer (83.67 mg/100g) while minimum at winter (70.17 mg/100g). Similarly maximum K was recorded at Dam site (96.08 mg/100g) while minimum at Jabri site (57.25 mg/100g).

Calcium (Ca) mg/100g:

The mean data of Ca for various seasons and sites is shown in Table-2. The results revealed that the effect of seasons and sites on Ca was significant while the effect of their interactions was non-significant.

Maximum Ca was observed at summer (105.79 mg/100g) while minimum at winter (84.17 mg/100g). Similarly maximum Ca was recorded at Dabola site (152.57 mg/100g) while minimum at Dam site (71.42 mg/100g).

4. Phosphorus (P) mg/100g:

The mean data of Phosphorus for various seasons and sites is shown in Table-2. The results revealed that the effect of seasons on P % was significant while the impact of sites and their interaction on P was non-significant.

Maximum P was observed at winter (171.72 mg/100g) while minimum at summer (135.72 mg/100g).

5. Magnesium (Mg) mg/100g:

The mean data of Mg for various seasons and sites is shown in Table-2. The results revealed that the effect of sites on Mg was significant while the effect of seasons and of their interaction was non-significant.

Maximum Mg was observed at Dam site (294.17 mg/100g) while minimum at Mang site (236.68 mg/100g).

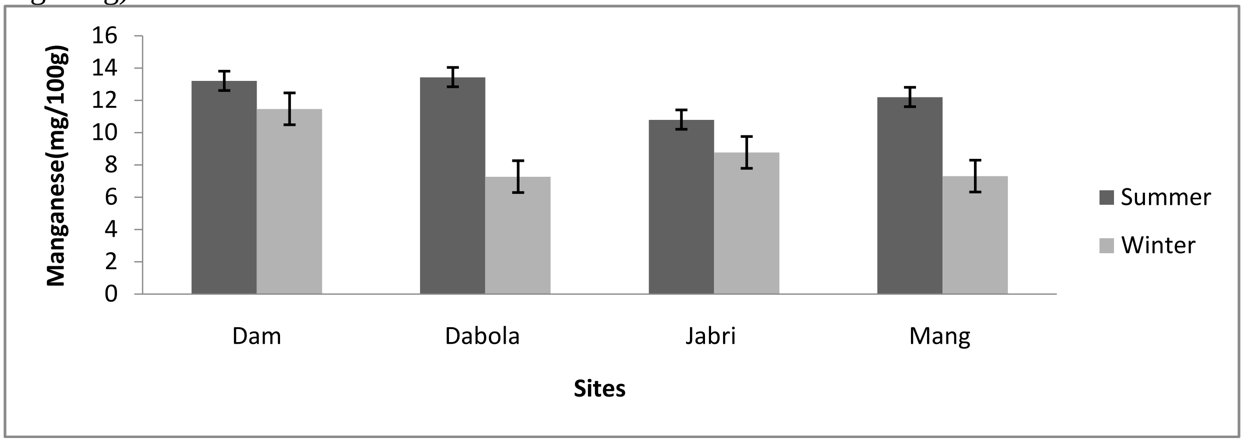

Figure-3.30: Effect of different seasons and sites on Manganese (Mn) contents in leaves of *Ricinuscommunis*.

6. Copper (Cu) mg/100g:

The mean data of Cu for various seasons and sites is shown in Table-2. The results revealed that the effect of seasons and sites on Cu was significant while the effect of their interactions was non-significant.

Maximum Cu was observed at summer (0.62 mg/100g) while minimum at winter (0.37 mg/100g). Similarly, maximum Cu was recorded at Dabola and Jabri sites (0.57 mg/100g) while minimum at Dam site (0.39 mg/100g).

7. Iron (Fe) mg/100g:

The mean data of Fe for various seasons and sites is shown in Table-2, while their interaction is shown in Figure-7. The results revealed that the effect of seasons, sites and their interaction on Fe was significant.

Maximum Fe was observed at summer (260.12 mg/100g) while minimum at winter (208.25 mg/100g). Similarly maximum Fe was recorded at Jabri site (279.08 mg/100g) while minimum at Mang site (197.58 mg/100g). In case of interactions maximum Fe was observed at Jabri site during summer (300.37 mg/100g) followed by Dabola site during summer (294.50 mg/100g). While minimum Fe was observed at Dabola site during winter (186.17 mg/100g).

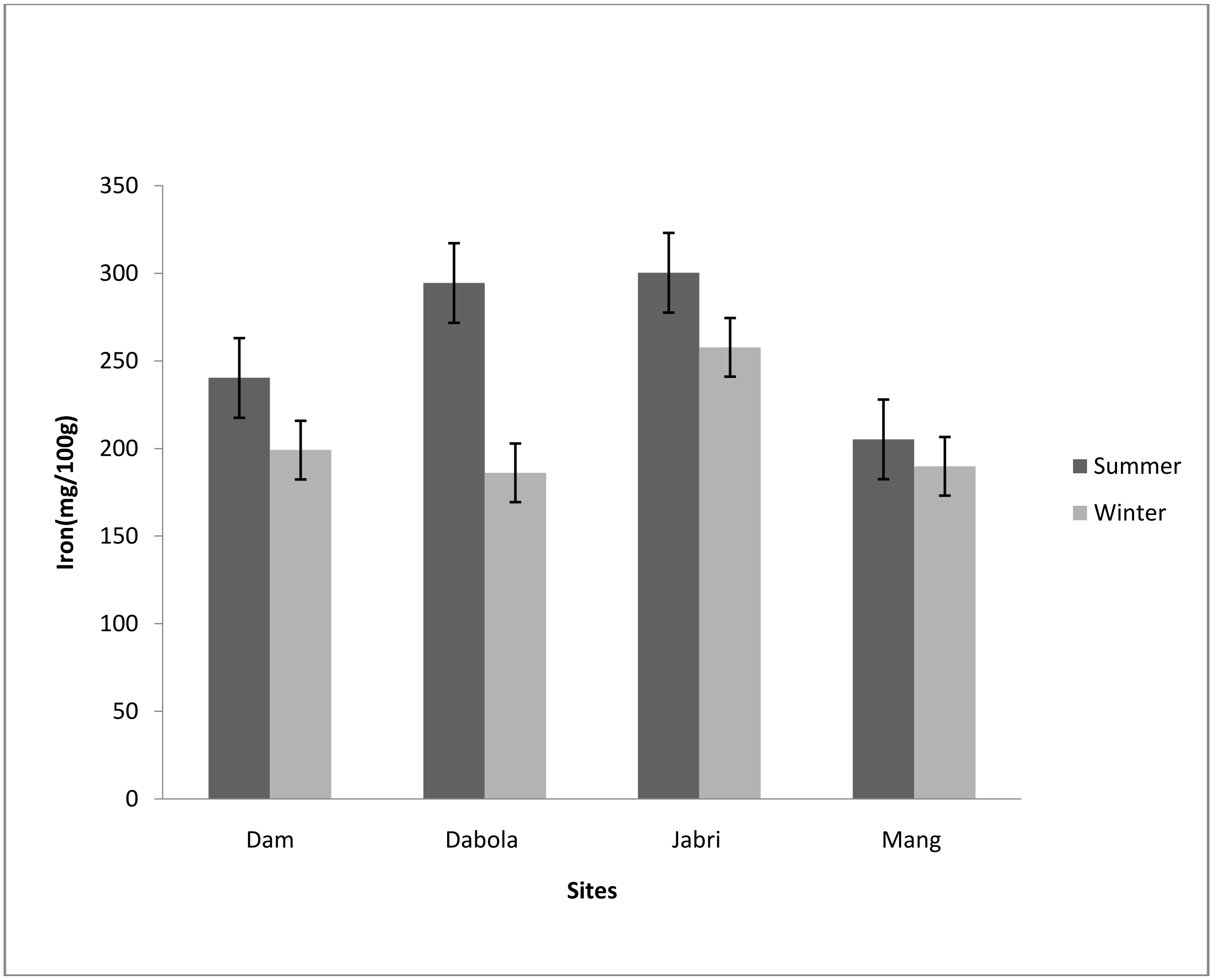

Figure-7: Effect of different seasons and sites on Iron (Fe) contents in leaves of *Ricinuscommunis*.

8. Manganese (Mn) mg/100g:

The mean data of Mn for various seasons and sites is shown in Table-2, while their interaction is shown in Figure-8. The results revealed that the effect of seasons, sites and their interaction on Mn was significant.

Maximum Mn was observed at summer (12.41 mg/100g) while minimum at winter (8.70 mg/100g). Similarly, maximum Mn was recorded at Dam site (12.33 mg/100g) while minimum at Mang site (9.75 mg/100g). In case of interactions maximum Mna was observed at Dabola site during summer (13.43 mg/100g) followed by Dam site during summer (13.20 mg/100g). While minimum Mn was observed at Dabola site during winter (7.27 mg/100g)

9. Zinc (Zn) mg/100g:

The mean data of Zn for various seasons and sites is shown in Table-2, while their interaction is shown in Figure-9. The results revealed that the effect of seasons, sites and their interaction on Zn was significant.

Maximum Zn was observed at summer (6.50 mg/100g) while minimum at winter (3.67 mg/100g). Similarly, maximum Zn was recorded at Mang site (7.15 mg/100g) while minimum at Jabri site (3.89 mg/100g). In case of interactions maximum Zn was observed at Mang site during summer (8.07 mg/100g) followed by Dam site during summer (7.13 mg/100g). While minimum Zn was observed at Dam site during winter (2.23 mg/100g).

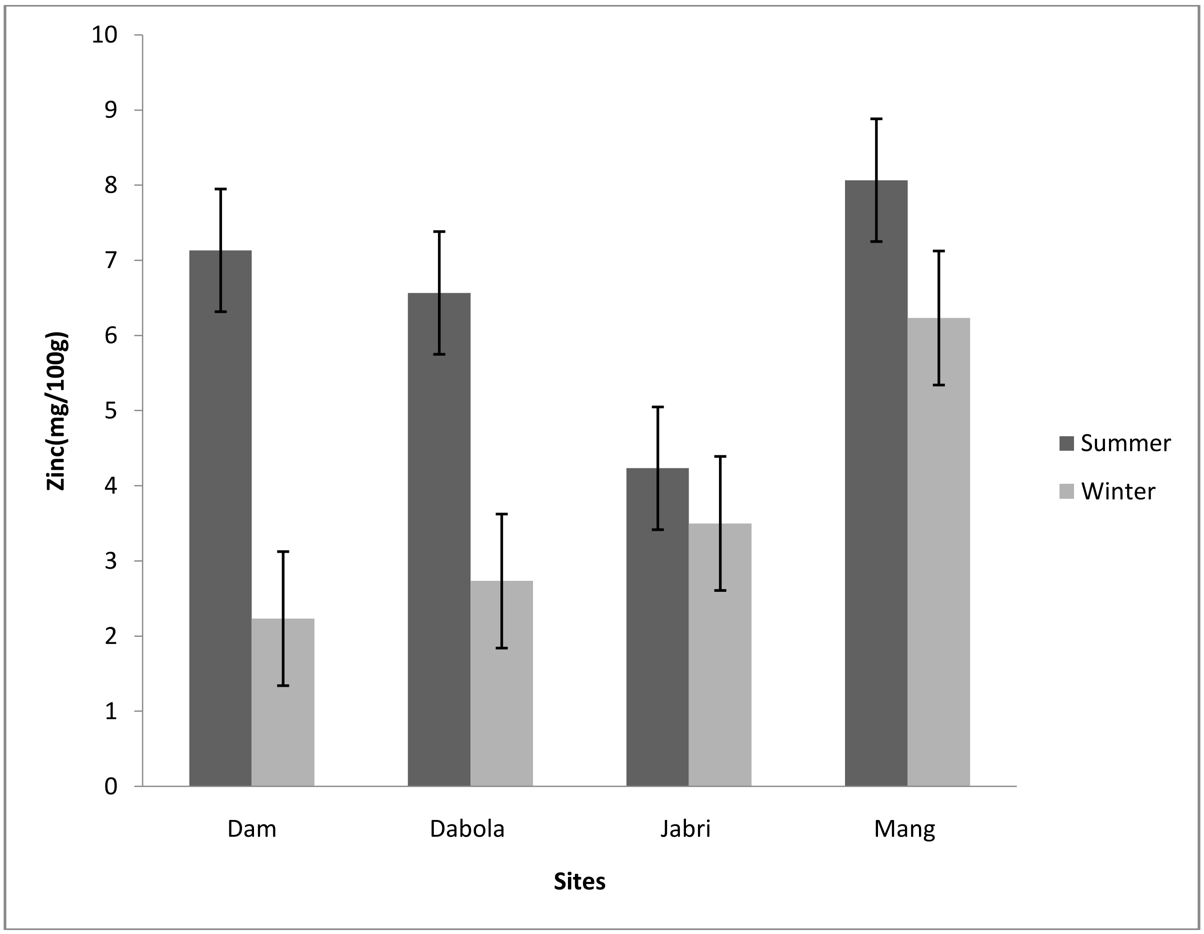

Figure-9: Effect of different seasons and sites on Zinc (Zn) contents in leaves of *Ricinuscommunis*.

The statistical analysis of the data recorded on bio-chemical attributes revealed that bio-chemical elements, Na, Ca, P, K, Cu, Fe, Mn and Zn, were found significantly higher in summer season than in winter season while Magnisium concentration in the leaves of *Ricinuscommunis* was non-significantly higher in summer than in winter. This might be due the finding that during summer, the mineral concentration remain high in most of the species (Dahanukar*et al*., 2000; Saboor et al., 2021) because mineral absorption is associated with high rate of transpiration due to high temperature during summer (Ayub et al., 2020: Tadayyon et al., 2018; Zheng et al., 2021). Another reason for higher concentration of minerals during summer might be that summer is more active period bio-chemically and photo synthetically as stated by Mehmood et al., 2018 and Omer, 2011.

The sites comparison revealed that Dam site produced maximum value for Na, K, Mg and Mn in the leaves of *Ricinuscommunis*. It was observed that the soil of Dam site was rich in K salts and having higher water holding capacity, as a result of which high K, Na, Mn and Mg were recorded in leaves of *Ricinuscommunis* (Mehmood et al., 2021: Pandey et al., 2009). Dabola site gave maximum value for Ca and Cu and Jabri site showed maximum results for Fe, P and Cu, which might be associated with environmental stresses as both the sites are at higher altitude (Galal et al., 2021; Huang et al., 2016). While Mang site produced maximum values for Zn, which is closely associated with the mineral composition of the soil of the site (Ma et al., 2015; Rajkumar and Freitas, 2008). This site to site variation show that the soil texture and environmental interactions at sites were different from each other and that many reports confirm the present findings (Yasur and Rani, 2013).

CONCLUSION

During the summer, Ricinuscommunis showed higher significant values for crude proteins (15.26 percent) in Mang, crude fibres (13.85 percent) in Dabola during winter, crude fats (10.24 percent) in Jabri during summer, essential oil (3.48 percent) in Mang during winter, NFEE (195.29 percent) in Jabri during summer, sodium (4.91 mg/100g) in Dam during the summer, iron (300.37 mg/100g) in Jabri during The biochemical content of Ricinuscommunis was highest in late July samples.

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An expert team from Hazara University, Mansehra joined the scholar on his first visits to provide technical help. Agronomists, industrialists, foresters, indigenous leaders were interviewed.

CONFLICT OF INTEREST:

The authors have stated that they have no conflicts of interest

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