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Short Research Article

Carbon and Nitrogen Content in leaf Tissue of Different Plant Species, Northeastern Mexico

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Abstract

The present study was undertaken to determine carbon and nitrogen content among 40 plant species of diverse growth habit with a view to select species with high carbon fixation (carbon content) and nitrogen content. In this study, we selected few species with high carbon fixation such as *Eugenia caryophyllata* (51.66%), *Litsea glauscensens* (51.54%), *Rhusvirens* (50.35%), *Gochantia hypoleuca* (49.86%), *Pinus arizonica* (49.32%), *Eryobotrya japonica* (47.98%), *Tecoma stans* (47.79%), *Rosamarinus officinalis* (47.77%). Few of these species could be recommended for plantation in CO_2 polluted areas to reduce carbon load. In addition these, high carbon concentration could serve as good source of energy. We selected few species with high nitrogen content such as *Mimosa malacophylla* (8.44%), *Capscicum annuum* (6.84%), *Moringa oleifer* (6.25%), *Azadirachta indica* (5.85%), *Eruca sativa* (5.46%), *Rosamarinus officinalis* (5.40%), *Mentha piperita* (5.40%). These species could serve as good sources of nitrogen for health care. We selected few species with high C/N ratio such *Arbutus xalapensis* (26.94%), *Eryngium heterophyllum* (24.29%), *Rhus virens* (22.52%), *Croton suaveleons* (20.16%), *Cinnamomum verum* (19.89%) which may be related to high production of secondary metabolites and antioxidants.

1. Introduction

Increasing global warming associated with incessant logging, illegal anthropogenic activities and conversion of forest to agriculture have increased greenhouse gases mainly CO_2 load in the atmosphere and resulted to cause pollution and climate change (Alig et al., 2002). There is a great necessity to reduce CO_2 load from the atmosphere. Innovations in carbon-fixation built the foundation for most major early divergences in the tree of life (Braakman et al., 2012). Most common form for deep-branching autotrophic carbon-fixation combines two disconnected sub-networks, each supplying carbon to distinct biomass components (Braakman and Smith, 2012). Okimoto et al. (2013) studied net carbon fixation of a representative mangrove tree in South-East Asia, *Rhizophora apiculata* and revealed that the value of annual net carbon fixation for 3, 4, 5 and 9 year-old forests was estimated to be 2.5-30.5 Mg C ha^{-1} yr^{-1}. Keller et al. (2003) considered that carbon sequestration is not a perfect substitute for avoiding CO_2 production because CO_2 leaks back to the atmosphere and hence imposes future costs.

Wang et al. (2013) studied variability of carbon concentration in different organs of *Larix olgensis* and ranked with descending order as living branch>bark>foliage>dead branch>stem; and in the below ground, it is ranked as large roots>stumps>thick roots>medium roots>small roots. The carbon concentration differs significantly between tree organs, while there is no significant difference between trees with different ages. Martin and Thomas (2011) made reassessment of carbon content in tropical treesand revealed thatwood C content varied substantially among species from 41.9-51% (Perez et al., 2013). Rocky Chauhan (2011) studied the habitat range of two alpine medicinal plants, *Aconitum naviculare* (Brühl) Stapf and *Neopicrorhiza scrophulariiflora* (Pennel) Hong in a trans-himalayan dry valley of central Nepal. The soil in rooting zone of the two plants differed significantly in organic carbon (OC), organic matter (OM), total nitrogen (N) and carbon to nitrogen (C/N) ratio.

Many plant species possess antioxidant properties. Ibrahim et al. (2011) reported that high peroxidation of secondary metabolites was produced in elicited in plants with high C/N ratio and low nitrogen fertilization especially when exposed to elevated CO_2 levels. Under low nitrogen, the growth and photosynthesis in plant showed increase in C/N ratio and increased the production of secondary metabolites. Therefore, high C/N ratio might be attributed to low nitrogen absorption of plants (Linderoth et al., 2002).

In indigenous Malaysian herb, Karcip Fatimah (*Labisia pumila* Blume) used in South East, the high production of secondary metabolites and antioxidants were highly correlated to low nitrogen content and high C/N ratio hereby showing correlation between secondary metabolites and anti-oxidant activity. Therefore, the consumption of *L. pumila* promotes several antioxidant activities (Mohd Hafiz et al., 2011).

2. Materials and Methods

This study was carried out at the experimental station of Facultad de Ciencias Forestales, Universidad Autonoma de Nuevo Leon, located in the municipality of Linares at an elevation of 350 m. The climate is subtropical or semiarid with warm summer, monthly mean air temperature vary from 14.7°C in January to 23°C in August, although during summer the temperature goes up to 45°C. Average annual precipitation is around 805 mmwith a bimodal distribution. The dominant type of vegetation is the Tamaulipan Thornscrub or subtropical Thorn scrub wood land. The dominant soil is deep, dark grey, lime-grey, vertisol withmontmorrillonite, which shrink and swell remarkably in response to change in moisture content. Medicinal plants traditionally used fordiabetes (Andrade Cetto and Henrich, 2005) were collected from botanical gardens of Forest Science Faculty, UANL. Mexico. The study was directed todetermine C, N, C/N of 40 medicinal plants used in diabetes.

Medicinal plant samples were collected and placed to dry on newspaper for a week. The leaves were separated from the rest of the plant and were passed twice through a mesh of 1×1 mm^2 in diameter using a mill Thomas Wiley and subsequently dried for more than three days at 65°C in an oven (Precision model 16 EG) to remove moisture from the sample and later these were placed in a desiccators. A 2.0 mg of the sample was weighed in a AD 6000 Perkin balance elmer in a vial of tin, bent perfectly. This was placed in Chons analyzer Perkin Elmer Model 2400 for determining carbon, hydrogen and nitrogen. For estimating the mineral contents, the samples were incinerated in a muffle oven at 550°C for 5 hours. Ashed sample is digested in a solution containing HCL and HNO_3, using the wet digestion technique (Cherney, 20000). Carbon and nitrogen of foliar contents (% dry mass basis) were carried out in 0.020 g of milled and dried leaf tissue by using a CHN analyser (Perkin Elemer, model 2400).

3. Results and Discussion

Table 2 shows the contents of C, N, and C/N in fourty medicinal plant species in Tamaulipan Thorn Scrub.

It is observed from the Table 1, the species (belonging to growth habit, mostly herbs and trees, few trees) showed large variability in the contents of carbon (C), nitrogen (N) and C/N ratio. Carbon concentration varied from 25.5 to 51.34%, nitrogen varied from 1.36 to 8.46%, C/N varied from 5.34 to 26.94%.

The large variability in carbon fixation among the species exhibited variabilty in the capacity of convertion of atmospheric CO_2 load to organic carbon stored in plants and also its capacity in reducing carbon load. The results of this study coincided with the finding of several authors owing to increasing global warming. Various studies had been directed in the estimation of carbon fixation and selection of species with high carbon fixation capacity in various species (Martin and Thomas, 2011, Jimnex Prez et al., 2013, Okonoto et al., 2013) to reduce atmospheric CO_2 lad, thereby reduce contamination. In this study, we selected few species with high carbon fixation such as *Eugenia caryophyllata* 51.66%, *Litsea glauscensens* 51.54%, *Rhus virens* 50.35%, *Gochantia hypoleuca* 49.86%, *Pinus arizonica* 49.32%, *Eryobotrya japonica* 47.98%, *Tecoma stans* 47.79%, *Rosamarinus officinalis* 47.77%. Few of these species could be recommended for plantation in CO_2 polluted areas to reduce carbon load. In addition, these plants with high carbon concentration could serve as good source of energy to the patients. Similar study had been undertaken by Perez et al. (2013) on carbon concentration of conifers where few species contain 51% carbon which coincided with few species in the present study.

Nitrogen content contributes to DNA and protein metabolism. The large variability in nitrogen content among the species in the present study exhibit its variability in protein metabolism, We selected few species with high nitrogen content such as *Mimosa malacophylla* 8.46%, *Capscicum annuum* 6.84%, *Moringa oleifer* 6.25%, *Azadirachta indica* 5.85%, *Eruca sativa* 5.46%, *Rosamarinus officinalis* 5.4%, *Mentha piperita* 5.40%. These species could serve as good sources of nitrogen for health care.

The present study also showed large variability in C/N which was related to the production of secondary metabolites, anti oxidants for health care and old age with capacity to reduce oxidation and other health benefits as reported by some authors (Safrini et al., 2002, Devasangyam et al., 2004, Monde and

Table 1. Leaf C, N, C/N content in different plant species used for different medicinal purposes

Common name	Scientific name	Family	Growth habit	%C	SD	%N	SD N	C/N	SD C/N
Albahaca	*Ocimum basilicum*	Lamiaceae	Herb	38.31	0.34	4.66	0.45	8.29	0.84
Alpistle	*Phalaris canariensis*	Poaceae	Shrub	40.73	0.53	2.84	0.52	14.78	2.87
Betonica o poleo de hoja ancha	*Hedeoma palmeri*	Lamiaceae	Shrub	46.38	1.66	2.83	0.78	17.14	3.33
Canela	*Cinnamomum verum*	Lauraceae	Tree	49.34	0.48	2.49	0.20	19.89	1.70
Charrasquilla	*Mimosa malacophylla*	Leguminosae	sub shrub	45.15	0.53	8.46	0.18	5.34	0.17
Chia	*Salvia hispanica*	Lamiaceae	Herb	44.68	2.18	5.24	0.62	8.59	0.81
Chile piquin	*Capsicum annum* L. var. *glabriusculum*	Solanaceae	Shrub	42.93	0.44	6.84	0.14	6.27	0.09
Clavo de olor	*Eugenia caryophyllata*	Myrtaceae	Tree	51.66	1.85	2.90	0.35	18.01	2.30
Colesia	*Eruca sativa*	Brasscaceae	Herb	41.13	0.72	5.48	0.64	7.59	0.90
Gigante	*Nicotiana glauca*	Solanaceae	Shrub	37.94	0.56	4.79	0.54	8.00	0.87
Gordolobo	*Gnaphalium canascens*	Asteraceae	Herb	37.73	1.26	2.56	0.32	14.89	1.37
H. del pajarito	*Lepidium virginicumun*	Brasscaceae	Herb	43.80	1.22	4.46	0.59	9.95	1.11
Hierba del sapo	*Erygium heterophyllum*	Apiaceae	Herb	40.90	0.65	1.75	0.40	24.23	4.89
Hierba de San Nicolas	*Chrysactinia mexicana*	Asteraceae	Shrub	45.04	0.48	3.39	0.49	13.56	2.46
Injerto	*Phoradendron villosum*	Viscaceae	Shrub	40.40	0.63	4.92	0.20	8.22	0.44
Lantrisco	*Rhus virens*	Anacardiaceae	SHRUB	50.35	0.59	2.27	0.45	22.92	4.67
Laurel	*Litsea glauscensens*	Lauraceae	Bush	51.34	0.28	3.36	0.45	15.50	2.03
Madrono	*Arbutus xalapensis*	Ericaceae	shrub	49.10	0.42	1.86	0.30	26.94	3.72
Maguey Todaro	*Agave macroculmis Todaro*	Agavaceae	Rosetofilus	41.32	0.74	1.36	0.21	31.05	5.11
Manrrubio	*Marrubium vulgare*	Lamiaceae	Herb	40.48	0.32	4.56	0.58	8.99	1.03
Moringa	*Moringa oleifer*	Moriginaceae	Tree	45.96	0.23	6.25	0.25	7.37	0.31
Neem	*Azadirachta indica*	Meliaceae	Tree	45.11	0.87	5.85	0.32	7.73	0.32
Nispero	*Eryobotria japonica*	Rosaceae	Shrub	47.98	1.18	3.03	0.35	15.98	1.58
Nogal	*Carya illinoiensis*	Juglandaceae	Tree	44.27	1.00	3.76	0.71	12.04	1.81
Nopal de t. ano	*Opuntiaficus indica*	Cactaceae	Shrub	25.53	0.99	2.36	0.43	11.10	1.94
Ocotillo	*Gochanatia hypoleuca*	Asteraceae	Shrub	49.86	0.87	3.59	0.50	14.11	1.89
Oregano	*Poliomintha longiflora*	Lamiaceae	Shrub	42.90	0.24	4.89	0.21	8.79	0.36
Ortiguilla	*Tragia ramosa*	Euphporbiaceae	Herb	42.68	1.16	3.89	0.63	11.22	2.01
Paistle	*Tillandsia usenoides* L.	Bromeliaceae	Calescent	44.10	1.61	1.56	0.71	31.32	8.20
Palo blanco	*Celtis laevigata*	Ulmaceae	Tree	39.45	0.51	3.01	0.18	13.13	0.70
Parralena	*Dyssodia setifolia*	Asteraceae	Herb	39.68	1.35	2.35	0.67	18.59	7.38
Pinoblanco	*Pins arizonica engelm*	Pnaceae	Tree	49.32	0.38	2.40	0.24	20.76	2.12
Romero	*Rosmarinus officinalis*	Lamiaceae	Shrub	47.77	5.43	4.54	0.24	10.57	1.65
Salvia	*Croton suaveolens*	Euphorbiaceae	Shrub	45.17	0.35	2.33	0.53	20.16	4.52
Tatalencho	*Tagetes lucida*	Asteraceae	Sub shrub	46.19	1.04	5.89	0.29	7.85	0.33
Tepozan	*Buddleja cordata*	Buddlejaceae	Tree	45.70	0.56	3.26	0.40	14.16	1.44
Tronadora	*Tecoma stans*	Bignoniaceae	Shrub	48.79	1.21	3.28	0.47	15.17	2.34
Yerbabuena	*Mentha piperita*	Lamiaceae	Herb	44.14	2.71	5.40	0.15	8.18	0.41

Data are means and standard deviation (n=5)

Youdinm, 2004, Aqui et al., 2006, Ibrahim et al., 2011). With this objective we selected few species with high C/N ratio such *Arbistis xalapensis* (26.94%), *Eryngium heterophyllum* (24.29%), *Rhus virens* (22.52%), *Croton suaveleons* (20.16%), *Cinnamomum verum* (19.89%). These species could have capacity in the production of secondary metabolites and antioxidants of high medicinal values as reported by various authors.

4. Conclusion

The present study showed large variability and offered good opportunity for the selection of species with high carbon concentration, high nitrogen content and C/N ratio. The species with high carbon fixation with arboreal habit could be planted in polluted areas and town planning to reduce CO_2 load.

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