TAXONOMIC SURVEY OF WILD PLANTS OF FAMILY BRASSICACEAE IN DISTRICT DIR UPPER, KHYBER PAKHTUNKHWA, PAKISTAN

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Abstract

The research area consisted of 16 wild plant species belonging to 11 genera of the Family Brassicaceae were collected from different localities of the research area. In which four plant species were belonged to genus *Cardamine, Lepidium* and *Thlapsi* had 2 species each, while *Alliaria, Capsella, Coronopus, Arabidopsis*, *Isatis, Erysimum, Sisymbrium, Nasturtium* had one species each. It was concluded that members of the Brassicaceae need consideration not only for their cultivation but attempt must be made on their conservation for sustainable exploitation of plant wealth.

Introduction

The study was conducted in District Dir Kohistan (DDK), which is located in Malakand division Khyber Pakhtunkhwa, Pakistan. The area is situated between 34º 10 N latitude and 72 º 20 E longitudes in sub-tropical dry temperate portion of Hindukush series. However, some area also lies in the moist temperate zone of the Pakistan. Geographically the Swat area lies in the East, Bajur Agency and Afghanistan in the West, District Dir lower in the South while Chitral in the North. The Dir Kohistan area is situated in the North East of Dir Upper which is encircled by the Hindu Raj on the North, North West by the Torwal and Gabral area in the East. Doddbah Sar Ghaer and Bataraei Ghaer located toward the South and South-west respectively (Khan *et al.,* 2010). District Dir Upper is one of among the 26 districts of KP province and covers an area of 3,699 sq km^2. Kohistan valley starts with its gate way called "Khawgo Ooba" and extended up to Kumrat about 120 km. However, according to forest division the area of Dir Kohistan 645 square miles. Out of this an area of 1, 40351 acres were covered by coniferous/pines forests (DCR, 1998).

The relative humidity is quite high throughout the year while maximum humidity has been recorded in January and February. The area provides habitat for the growth of a large number of plants. It has rich diversity of plant resources. Brassicaceae, the flowering plant family also known as "Cruciferae" (cross bearing). The family contains many species of great economic importance. This family provides much of the world's winter vegetables; these include cabbage, cauliflower, turnip, radish etc. The other well-known members of the family include mustard and *Arabidopsis thaliana*, which is the model organism and the most intensely studied member of the Brassicaceae. It is an important family of the plant kingdom which includes several plants of major economic importance (Bhati *et al*., 2010).

Materials and Methods

The area was surveyed throughout the year from time to time in order to collect plant specimens belonging to the selected family. It provides an opportunity to make maximum plant collection and field observations during the flowering and fruiting seasons. So, therefore regular field trips were arranged in different seasons of the year, especially in spring season because most of the species appears in this season. Eleven sites were selected which had different habitat conditions and were regularly visited from October 2011 to August 2012. But most of the species were collected in March, April and May. The sites were sheingal, Kalkot, Janus Kandawo Shahoor, Barikot, Lamuthai, Gwaldai, Junkae, Thall, Jandari and Kumrat. The collected species were identified and named through the available literature [Ali and Nasir, 2005-2008] and Flora of Pakistan [Nasir & Ali, 1970-1979: Nasir & Ali, 1980-1989: Ali & Nasir, 1989-1992: Ali & Qaiser, 1993-2009]. These species were dried and preserved and mounted on a standard herbarium sheets of size (11* 16) inches and were submitted to Herbarium. Voucher numbers were allotted and deposited in the herbarium of Botany Department, Shaheed Benazir Bhutto University and University of Malakand, Chakdara. The taxonomic descriptions of the collected species were also written and keys to the species were made. Questionnaire method was also used to collect information from local farmers.

Results

The results revealed that a total of 16 species belonging to 11 genera of the Brassicaceae were identified from the research area. 4 species belonged to genus *Thalpsi*, 2 species to genus *Cardamine* and *lepidium*, while *Alliaria, Arabidopsis , Capsella, Coronopus, Erysimum, Isatis, Nasturtium, Sisymbrium* having one species each The aim of study is to explore, document and identify the maximum number of wild species of Brassicaceae in the research area. In order to explore the species of the Brassicaceae, the taxonomy and ecology were considered. The taxonomic notes were written on each plant. Which were also determined and studied in the following table.

Table 1. Check list of wild plants species of Brassicaceae of Dir upper.

S. No	Voucher. No	Botanical Name	Vernacular Name
1.	505	*Alliaria petiolata* (M.Bieb.) Cav. & Grande	Spengulae
2.	893	*Arabidopsis himalaica* (Edgew.) Schulz	Sfenaponga
3.	504	*Capsella bursa-pastoris* (L.) Medik.	Bambesa
4.	864	*Cardamine loxostemonoides* O.E. Schulz	Sharshamaey
5.	833	*Cardamine impatiens* L.	Sharshamaey
6.	941	*Coronopus didymus* (L.) Smith	Gandabotae
7.	805	*Erysimum melicentae* Dunn	Zergulaey
8.	983	*Isatis costata* C. A. Mey.	Tora pana
9.	807	*Lepidium pinnatifidum* Ledeb.	Nil
10.	993	*Lepidium sativum* Linn.	Halam
11.	844	*Nasturtium officinale* R. Br.	Tarmira
12.	982	*Sisymbrium irio* Linn.	Jnjan
13.	992	*Thlapsi kotschyanum* Boiss. & Hohen.	Mandanaey
14.	834	*Thlapsi cochleariforme* DC.	Thurapana
15.	920	*Thlapsi perfoliatum* L.	Barscana
16.	742	*Thlapsi andersonii* (H. & T.) O.E. Schulz	Halamana

Key to the Genera

1. Fruit Siliculae ----------2
+ Fruit Siliquae ----------6
2. Seed 1-2 only----------4
+ Seed more then two----------3
3. Seed 6-12---------- ***Capsella***
+ Seed more then 12---------- ***Thlaspi***
4 Petals minute or absent---------- ***Coronopus***
+ Petals otherwise----------5
5 Stigma capitate---------- ***Lepidium***
+ Stigma bilobed---------- ***Isatis***
6 Leves compound----------7
+ Leaves simple----------8
7 Stigma bilobed---------- ***Cardamine***
+ Stigma capitate---------- ***Nasturtium***
8 Leaves lyrate-Pinnatipartite---------- ***Sisymbrium***
+ Leaves otherwise----------9
9 Flower color yellow----------***Erysimum***
+ Flower color white----------10
10 Ovary 4-18 ovules---------- ***Alliaria***
+ Ovary 20-100 ovules---------- ***Arabidopsis***

Capsella bursa-pastoris Mk., Pflanzengatt.1:85.1792.

Annual herbs, erect, simple or branched, glabrous to hairy with simple and branched hairs. Basal leaves often rosulate, pinnate to entire, stalked, upper leaves sessile, sinuate dentate to entire, auricled, amplexicaul. Racemes to corymbose, and elongated in fruit, ebracteate. Flowers small, usually white, pedicel filiform, ascending in

fruit. Sepals suberect, oblong, not saccate at base. Petals short, white or pinkish, spathulate, apex rounded. Stamens 6, filaments linear, anthers ovate. Lateral nectar glands in pairs, usually with a short external process. Ovary oblong, elliptic, 12-24-ovuled, bilocular; stigma subsessile. Siliculae obtriangular or obcordate-triangular, compressed, bilocular, dehiscent, not winged, glabrous; valves wideest near the apex, reticulately veined; septum narrowly elliptic, membranous, not veined; seeds 5-12 in each locule, small, ellipsoid, brown; radicle incumbent. *Fl. Per*.: April-May, 200-3000m.

Genue : ***Thlaspi*** L. Sp. Pl. 2: 645–647. 1753.

Key to the speeies of thalaspi genus

1 Siliculae completely winged, orbicular to widely obcordate---------- ----------2
\+ Siliculae winged above only, or wings suppressed or absent, usually oblong----------3
2 Wings of siliculae narrow, not veined----------***Thlaspi perfoliatum***
\+ Wings of siliculae wide, reticulately veined----------***Thlaspi kotschyanum***
3 Flowers 3-5 mm across; fruits oblong or obtriangular; apex slightly winged---***Thlaspi cochleariforme***
\+ Flowers 6-7 mm across; fruit oblong elliptic; Apex not winged----------***Thlaspi andersonii***

Thlaspi perfoliatum L., Sp. PI. 646. 1753.

Annual plant body, 4-20 cm tall, erect, simple or branched from below, glabrous, Basal leaves in loose rosette, obovate, spathulate, apex rounded, shortly stalked, 1-3 cm long, 1-1.5 cm wide, upper leaves lanceolate, ovate, cordate, amplexicaul; all leaves glabrous, ± glaucous, entire or slightly toothed. Racemes 15-30-flowered, up to 15 cm long in fruit. Flowers is 2.5 mm across, white, pedicels up to 9 mm long in fruit, spreading. Sepals 2 mm long, 1 mm wide. Petalss 2.5 mm long, 1 mm wide. Stamens 1.2: 1.5 mm long. Siliculae 4-6 mm long, 3-5 mm wide, obcordate-orbicular; wings narrow, smooth, not veined; stigma subsessile at the base of the apical notch; septum 2 mm wide; seeds 2-3 in each locule, 1.5 mm long, ellipsoid, yellowish-brown. *Fl. Per*.: April-July.1500-2500m.

Thlaspi kotschyanum Boiss.& Hohen. in Boiss,. Diagn. ser. I:39. 1849.

Annual, 25 cm tall, erect, branched usually below glabrous. Basal leaves not rosette forming, ovate-oblong, 2-3 cm long, 1-1 cm wide, entire or subentire, shortly stalked; upper leaves oblong-ovate, 1-4 cm long, 1-2 cm wide, cordate, amplexicaul, apex obtuse or rounded. Racemes 25-50-flowered, up to 15 cm long in fruit. Flowers 2 mm across, white; pedicels up to 5 mm long in fruit, sub-spreading or ascending. Sepals 1.2 mm long, 0.5 mm wide. Petals 2 (-3) mm long, 1 mm wide. Stamens 0.8 :1 mm long; anthers 0.2 mm. Siliculae obcordate-orbicular, 9-12 mm in diam, apical notch narrow with a sessile stigma at its base; wing wideest towards the apex; 1-2.5 mm wide, distinctly reticulately veined; septum 1.5-2 mm wide; seeds usually 6 in each locule, 1.5 nun long, reddish-brown. *Fl. Per*.: April-July, 1600-2000m.

Thlaspi cochleariforme DC., Syst. Nat. 2:381. 1821.

Perennial, 5-25 cm tall in fruit, branched mostly from the base, erect, glabrous, subglaucous; rootstock 3-4 mm thick, covered with withered leaf bases. Radical leaves rosulate, spathulate or oblong-obovate, shortly stalked, 2.5-6 cm long, 0.5-2 cm wide, apex rounded, entire or subentire; cauline leaves ovate-cordate, amplexicaul, 1-3 cm long, entire or obscurely toothed. Racemes 20-40-flowered, up to c. 10 (-15) cm long in fruit. Flowers c. 5 mm across, white, pedicels 8 mm long in fruit, glabrous, spreading rarely slightly deflexed. Sepals 2.5-3 mm long, 1.3 mm wide. Petals 5-7 mm long, 2-2.5 mm wide, obovate, cuneate below, apex slightly emarginate. Stamens 2.3: 4 mm long; anthers 0.5 mm. Siliculae 4-10 mm long, 2.5-3.8 mm wide, oblong-obovate, apex ± emarginate, rarely subentire, glabrous, obscurely to slightly winged at the apex with 1-2.5 mm long persistent style; septum 1.5 mm wide, seeds 3-4 in each locule, 1-2 mm long, ovate-oblong, pale brown. Fl. Per.: April July. 1300-2200m.

Thlaspi andersonii (Hook. f. & Thorns.) O.E. Schulz in Anzeiger. Akad. Wiss.Wien., Math-Nat. K1. 43 :98. 1926.

Perennial, procumbent or ascending, 7-15 cm long, glabrous, subfleshy; branches dimorphic, flowering ones with cordate amplexicaul leaves, non-flowering ones with spathulate, cuneate or stalked leaves. Radical leaves ± rosulate, spathulate ± stalked, 10-30 mm long, 4-12 mm wide, margin± dentate; cauline leaves of flowering branches ovate-oblong, 5-11 mm long, 4-8 mm wide, auricled at base, amplexicaul. Racemes 15-20-flowered, corymbose, upto 4 cm long in fruit. Flowers 6-7 mm across, white or pinkish; pedicels up to 5 mm long in fruit, glabrous, spreading. Sepals 2-2.5 mm long, 1.2 mm wide. Petals 5-6 mm long, 2.5 mm wide, oblong-obovate. Stamens 2.5 : 3.5 mm long, anthers 0.7 mm. Siliculae 6-8 mm long, 2 mm wide, elliptic-oblong, not or obscurely winged, apex acute, entire. *Fl. Per*.: May-July. 1400-2400m.

Coronopus didymus (L.) Smith, Fl. Brit. 2: 691.1804.
Annual or biennial plant body, 14-30 cm long, procumbent, branched mostly from below, glabrous or hairy. Basal leaves are rosulate and pinnatisect, stalked, 5-10 cm long, upper leaves similar, 1-3 cm long, sessile, lobes is sinuate to toothed, often only on one side. Racemes 29-60-flowered, dense, 8 cm long in the fruit. Flowers minute, l mm across, pedicel short, 3-4 mm long in fruit, filiform. Petals present. Stamens only 2 or 4, but only 2 fertile. Siliculae shorter than the pedicel, 1 mm long, 3 mm wide, wideer than long, valves globose, reticulately, glabrous, septum inconspicuous, 0.3 mm wide; seed, 1.5 long, reniform, reddish, brown. *Fl.Per*.: March-June. 1000-3200m.

Genus: ***Lepidium*** L. Sp. Pl. 2: 643–645. 1753.

Key to the species

1 Siliculae often deeply notched at the apex, usually 5-6 mm ong----------***Lepidium sativum***
\+ Siliculae slightly or obscurely notched at the apex, usually 2-3 mm long---***Lepidium pinnatifidum***

Lepidium sativum L., Sp.P1. 644. 1753.
Annual, 30-61 cm tall, straight, divided branches, glabrous and pilose, basal leaves pinnatisect, 4-11 cm long, 2.6-3.6 cm wide, petiolate to sub-sessile, top leaves linear and sessile, inflorescence racemes, branched, each 19-31 flowered and ebracteate. Flowers are small, 3.1 mm across, white to pinkish, pedicel 2-4 mm long in fruit, subappressed, sepals 1.6 mm long, 1.1 mm wide, oblong, petals 4 mm long, 01 mm wide, pointed below, tip rounded, stamens 2.2 mm long; anthers minute widely elliptic, glabrous, hardly winged and definitely notched at tip with short style included within, septum 01 mm wide. Seed 3 mm long, 01 mm wide, brown. *Fl. Per.* April-June.1000-2500m.

Lepidium pinnatifidum Leb., Fl. Ross.01: 206. 1842.
Annual (or biennual), up to 50 cm tall, with a single stem usually branched, glabrous aree rarely very thinly hairy with simple short hairs. Basal leaves sub-pinnatipartite or obscurely dissected, shortly petiolate, somewhat rosulate, drying early, cauline leaves usually elliptic to oblanceolate, irregularly to dentate generally 2-5 cm long, upper almost entire toothed, linear, oblanceolate or sub-spathulate. Flowers and fruits like the above, species but petals usually present, rudimentary and shorter than sepals; pedicels hairy, slightly longer and comparatively more spreading, 3.5-5 mm long. *Fl. Per*.: April-June. 800-3000m.

Isatis costata C. A. Mey. in Ledeb; Fl-Alt. 03: 204. 1831.
Annual or mostly biennial, 38-120 cm tall, erect, branched, in fact it is glabrous. Basal leaves obovat, 7-14 cm long, 1-3 cm wide, subsessile, margin entire, cauline small leaves, lanceolate to auricled at base, amplexicaul, entire, all the leaves glabrous or sparsely ciliately hairy with simple hairs. Flower 2-4 mm across, yellowish. Sepals 1-1.7 mm long, 1 mm wide. Petals 2-3 mm long, 1-2 mm wide, Siliculae or oblong is elliptic, 9-15 mm long, 4-6 mm wide, glabrous or pubescent, apex is rounded, locules, usually as long or a little longer than the upper portion of the wing, midrib3 ridged, seed 3 mm long, 1 mm wide, oblong-ellipsoid, brown. *Fl. Per*.: May-August. 700-2000m.

Genus: ***Cardamine*** L., Spe. Pl. 653. 1753.

Key to the species

1 Leaf bases auricled----------***Cardamine impatiens***
\+ Leaf bases not auricled----------***Cardamine loxostemonoides***

Cardamine impatiens L., Sp. Pl. 655. 1753.
Annual or biennial herb, 10-60 cm tall, erect or suberect, glabrou or hairy. Leaves very variable in size, and pinnate, usually with 5-8 pairs of lateral leaflets and a terminal one, stalked with bases of petiole auricled; leaflets usually subrounded in lower leaves and ovate-oblong in upper leaves, lobulate, serrate to almost entire, 5-25 mm long, 3-10 mm wide. Racemes 20-30 flowered, 15 cm long in the fruit. Flowers 3-4 mm across, white, pedicels 10 mm long in fruit, ascending. Sepals 2.5 mm long. Petals 4 (-5) mm long. Stamens 2-3 mm long. Siliquae linear, compressed, (15) 20-30 mm long, 1 mm wide, straight, glabrous; valves faintly veined; style usually very short, 1 mm long with minute stigma; septum not veined; seeds many, 1 mm long, oblong. *Fl. Per*.: May -July.1500-2000m.

Cardamine loxostemonoides O. E. Schulz in Notzbl. Bot. Cart. Berelin. 9: 1069. 1927.
Perennial creeping rhizome, suberect or procumbent, 10-20 cm long, glabrous. Leaves pinnate, stalked, usually 4-7 jugate, very variable; pinnae sub-orbicular to linear oblong, 4-15 (20) mm long, 2-5 mm wide; terminal lobe scarcely different lateral ones, entire to 3-lobulate. Racemes 5-15-flowered, 10 cm long in the fruit. Flowers 10-15 mm across, showy, usually lilac or pedicel 10-20 mm long in the fruit. Sepals 3.5 mm long. Petals 3 times as long as the sepals, 5-8 mm wide, obovate-oblong, hardly clawed, veined. Stamens 4:5 mm long. Siliquae linear,

compressed, 2.5-3 cm long, 1.5 mm wide, straight, glabrous; style 1-3 mm long with a capitate stigma; septum not veined; seeds many, 1.5 mm long. Fl. Per.: June-July.700-1600m.

Nasturtium officinale R. Br. in Aton, Hrt. Kew. ed. 2. 4: 110. 1812.
Perennial herb, rhizomatous, 7-81 cm long, rooting at below the nodes, floating, glabrous green, simple scattered hairs. Leaves pinnate, lower stalked 1-5 leaflets, in the upper sessile, leaves and stem green in autumn, racemes is 9-25 number of flowered, flowers 4 mm, white, pedicel 9.1 mm long in the fruit, spreading, horizontal, sepals 3.1 mm long, petals 3-5 mm in long, 2 mm wide, stamens 1-3 mm long, siliquae oblong, 9-20 mm long, 1-2.5 mm wide. Style 1-2 mm in long with depressed stigma, the seeds many, ovoid, 1 mm long with 25 polygonal. *Fl. Per.* April-July. 800-2000m.

Sisymbrium irio L., Sp. Pl. 659. 1753.
Annual, herb, 20-60 cm tall, straight, branched, hairy, basal and lower leaves petiolate, pinnately lobed with a hastate terminal lobe larger than laterals, 2-6-jugate, very variable in size; cauline leaf is similar but only 1-3-jugate, racemes 50-80 flowered, up to 30 cm long in fruit with siliquae overtopping young flowers and buds, flowers 3 mm across, yellow; pedicels 10-15 mm long in fruit, filiform, ascending or sub-spreading, rarely spreading, sepals 2-2.6 mm long, petals 3-5 mm long, 1 mm wide, usually slightly longer than sepals, stamens 1.4 mm long, anthers 0.6 mm long, siliquae 30-45 mm long, 1 mm wide, linear, valvex submembranous, convex, obscurely to distinctly torulose, faintly 3-veined but the mid-vein distinct, glabrous; style inconspicuous, thickened, with a depressed, sub-bilobed stigma; septum hyaline, the seeds 20-40 in each locule, 01 mm long, oblong-ellipsoid, yellowish-brown. *Fl. Per.* May-August. 700-2000m.

Erysimum melicentae Dunn in Kew Bull. 336. 1920.
Biennial or perennial. (20-) 30-80 (-100) cm tall, usually with simple stem, leafy, appressedly hairy with 2 (-3) -partite hairs. Basal leaves rosulate, oblanceolate, stalked, 50-100 mm long, 5-10 mm wide, obtusely toothed, rarely sinuate-dentate or entire; cauline leaves ± similar, shortly stalked, upper linear, sessile or subsessile. Racemes 25-50 (-70)-flowered, sometimes bracteate below, 20 cm long in the fruit. Flowers large, 10-15 mm, the yellow; pedicels 9-15 mm long in fruit, thickened. Sepals 7-9 mm long. Petals 12-18 mm long, 6-9 mm wide. Stamens 8: 10 mm long; anthers 3 mm long. Siliquae 35-70 mm long, 1.5 mm wide, linear-terete, appressedly hairy, often densely, valves with a prominent mid-rib; style 2-5 mm long, with large, capitate, sub-bilobed stigma, seeds 2 mm long, oblong-terete. *Fl. Per*.: May-July. 600-3000m.

Alliaria petiolata (M.Beb) Cavra & Grnde, Bull.Orto Bot. Rgia Univ. Napli. 3: 418. 1913.
Annual and may be biennial herbs with slender tap root, often having an odour of garlic, erect, branched, sparsely hairy below with simple hairs. Basal leaves ovate-cordate, dentate, long petioled; cauline leaves ovate-triangular, shortly stalked. Racemes many flowered, lax, enlongated in fruit. Flowers mediocre or small, white; pedicels spreading, thickened in fruit. Sepals not saccate at base. Petals twice as sepals, oblong obovate, narrowed below. Stamens 6; filaments not appendaged; anthers short, obtuse. Lateral nectar glands annular, sub-angular; middle glands widely conical, hardly joining the laterals. Ovary cylindrical-terete, 4-18-ovuled; style short with depressed-capitate stigma. Siliquae widely linear, terete, bilocular, dehiscent; valves 3-veined; septum membranous, white, not veined; seeds 1-seriate, large, oblong, longitudinally striated, not mucilaginous when wet. *Fl. Per*.: May-June.1200-3000m.

Arabidopsis himalaica (Edgew.) O.E. Schlz in Engl., Pflnzenr. 86 (IV.105): 283. 1924.
Biennial or perennial, 20-50 cm is tall, often much branched and base of the branches ascending, usually densely hispid with simple and branched hairs. Leaves often more coarsely toothed and green. Racemes and flowers similar but mostly bracteate up to the apex; pedicels up to 9 (-15) mm long in fruit, spreading. Siliquae linear, subterete, (10-) 15-30 (-40) mm long, c. 1 mm wide, glabrous valves 1-veined, subconvex; style 0.5 mm long with a depressed, stigma, septum 1-veined; seeds 25-50 in each locule, 0.7 mm long. *Fl. Per*.: May-June. 1100-2500m.

Discussion

Research area has a rich biodiversity. This survey was undertaken with an aim to explore, identify and document the members of the Family Brassicaceae. In future, it will be helpful a good draft to serve the conservation and sustainable utilization of plant resources of the area. So in the light of recorded data, a total of 16 wild plant species belonging to 11 genera of the family were collected from the targeted area. The selected family included several species of considerable economic importance especially as vegetable crops and sources of spices and edible and industrial oils. Brassicaceae is an important family of the plant kingdom which includes several plants of major economic importance [Bhati *et al*., 2010]. As most of the flora of the district are endamic

so, the plants belonging to Brassicaceae collected from the research area are mostly used as medicnal. Among the aquatic species belonging to Brassicaceae only one species were reported from the research area *Nasturtium officinale.* The later species is mostly aquatic or amphibious and found on the sides of streams. Phenological study was also taken into consideration most of the species of Brassicaceae may be are wild or cultivated or ornamental generally bloom in spring season in the research area. Mostly the cultivated and ornamental species of this family have beautiful colors of their flowers which attract insect for pollination. A study have claimed that flower in bloom in particular time of year are much likely to be of particular color to better attract pollinating insects (Arnold *et al*., 2009). The member of Brassicaceae, have different habitats some were present in the desert and hilly area, some are inhabited in plains area on roadsides, waste places etc.

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