Numerical Taxonomic Analysis on Some *Lepidium* L. taxa (Brassicaceae) from Turkey

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Please cite this article as: Bona M. Numerical Taxonomic Analysis on Some *Lepidium* L. taxa (Brassicaceae) from Turkey. Eur J Biol 2020; 79(2): 132-143. DOI: 10.26650/EurJBiol.2020.0020

ABSTRACT

**Objective:** This study reveals the relationship between *Lepidium campestre*, *L. spinosum*, *L. sativum* ssp. *sativum*, *L. sativum* ssp. *spinescens*, *L. ruderalis*, *L. virginicum*, *L. perfoliatum*, *L. vesicarium*, *L. caespitosum*, *L. ruderale*, *L. perfoliatum*, *L. vesicarium*, *L. caespitosum*, *L. pumilum*, *L. cartilagineum*, *L. latifolium*, *L. lyratum*, *L. graminifolium*, to determine the effectiveness of the characters used in taxonomic classification, and to help solve taxonomical problems of this large genus at the specific and intraspecific levels by comparing the numerical results with classical taxonomic classification.

**Materials and Methods:** This numerical taxonomic study is based on morphological data that come from a wide range of herbarium material and material collected in the wild. For the analyses, 14 taxa were studied. A range of characteristics of sepal, petal, silique, pedicel, septum, stigma, and sinus that are considered to be taxonomically important in the genus were investigated. Morphological data, 90 character states, which belong to 55 characters scored as the binary state for each taxon were used in unweighted pair–group method using arithmetic averages and principle components analyses.

**Results:** *L. caespitosum*, *L. pumilum* and *L. cartilagineum* are recognised at species rank, not subspecies or varieties. *L. sativum* ssp. *sativum* and *L. sativum* ssp. *spinescens* should be evaluated as two subspecies not synonyms of *Lepidium sativum*. The most effective characters for the delimitation of the studied taxa are seed length, the habitus of plant, sepal length, septum length, seed wings, the presence of swelling leaf residues on the base of the plant, pedicel length.

**Conclusion:** Numerical analysis studies based on morphological data on *Lepidium* taxa growing in Turkey are a useful tool for solving the taxonomic problems of taxa belonging to the genus *Lepidium*.

**Keywords:** Brassicaceae, *Lepidium*, Numerical Taxonomy, PCA, UPGMA

INTRODUCTION

The Brassicaceae is one of the largest families that has major scientific and economic importance (1,2). There are 3660 species and 321 genera in 49 tribes in the family (3). The classification of the Brassicaceae is problematic because the characters traditionally used are variable, even within genera, and may not support natural groups (4).

The first comprehensive taxonomic approach of the Brassicaceae is based on two characteristics: the position of the radicle with cotyledons in the seed and fruit type (5). After almost a century, tribal and subtribal classification revised mainly based on fruit characters and seed morphology (6). Brassicaceae is represented by 555 species and 91 genera in the Flora of Turkey (6-9). Generic delimitation has been changed according to molecular phylogenetic studies focused on Brassicaceae in the last two decades (10-12). Recent studies show that Turkey is a centre of diversity with 660 taxa belonging to 91 genera, including 571 species, 65 subspecies, and 24 varieties (13).

The genus *Lepidium* L. is primarily distributed in temperate and subtropical regions (14). The genus includes 250 species and one of the largest genera in the Brassicaceae (3). *Cardaria* Desv. was defined as...
a section of *Lepidium* (15), later it was accepted as a separate genus (7,14,16). In light of molecular research not only *Cardaria* but also *Coronopus, Stroganowia, Winklera* Regel, and *Stubendorfia* Schrenk ex Fisch., C.A. Mey. & Avé-Lall. have been classified within *Lepidium* sensu lato (10,12,17-20).

*Cardaria, Coronopus, and Stroganowia* are represented by five species in Turkey: *L. coronopus* (L.) Al-Shehbaz and *L. didymium* L. (formerly *Coronopus*), *L. draba* L. and *L. chalepense* L. (formerly *Cardaria*), *Stroganowia leventii* V.I. Dorofeev (3,21-23)

*Lepidium* sensu stricto (excluding *Cardaria, Coronopus, and Strogonovia*) includes 13 species and 2 subspecies in Turkey (7,8,24).

Numerical taxonomy is a grouping method that groups to a taxonomic unit based on their character states using statistical methods (25). In this study, the morphological features of *Lepidium* s.str. taxa distributed in Turkey were examined and their diagnostic characteristics were determined. Detailed measurements based on these characters were used in numerical taxonomic analyses.

This study reveals the relationship between *L. campestre, L. spinosum, L. sativum ssp. sativum, L. sativum ssp. spinescens, L. ruderale, L. virginicum, L. perfoliatum, L. vesicarium, L. caespitosum, L. pumilum, L. cartilagineum, L. latifolium, L. lyratum, L. graminifolium*, to determine the effectiveness of the characters used in taxonomic classification, and to help solve taxonomical problems of this large genus at specific and intraspecific ranks by comparing the numerical results with classical taxonomic classification.

**MATERIALS AND METHODS**

The flowering and fruiting material of the genus *Lepidium* were collected from different parts of Turkey during the period May-August 2008, 2009 and 2010. Specimens were collected from as many different parts of the distribution area of the genus as possible in order to thoroughly examine variation patterns. The specimens collected were kept at the Istanbul University, Department of Pharmaceutical Botany Herbarium (ISTE) and compared with the collections of ANK, E, GAZI, HUB, ISTF, ISTE, K, and VAN herbaria.

A range of characteristics of sepal, petal, stamen, silicle, pedicle, septum, stigma, and sinus that are considered to be taxonomically important in the genus were investigated. For these investigations, all parts of the specimens were photographed using MOTIC 2000 camera stereo microscope system, and then measured by using Motic Image Plus 2.0-program. These measurements were used for numerical analyses. For the analyses, 14 taxa (Table 1) and 90 character states, which belong to 55 characters, were scored as the binary state for each taxon (Table 2). To investigate the relationships between the studied taxa,
Table 2. Continue

| C9   | Fruit width minimum value | Shorter or longer than 2 mm |
|------|---------------------------|-----------------------------|
| C10  |                           | Shorter or longer than 3 mm  |
| C11  | Pedicel length maximum value | Shorter or longer than 4 mm  |
| C12  |                           | Shorter or longer than 6 mm  |
| C13  | Pedicel length minimum value | Shorter or longer than 2 mm  |
| C14  |                           | Shorter or longer than 3 mm  |
| C15  | Septum length maximum value | Shorter or longer than 2.5 mm |
| C16  |                           | Shorter or longer than 3.5 mm |
| C17  | Septum length minimum value | Shorter or longer than 2 mm  |
| C18  |                           | Shorter or longer than 3 mm  |
| C19  | Septum width maximum value | Shorter or longer than 0.7 mm |
| C20  | Septum width minimum value | Shorter or longer than 0.5 mm |
| C21  | Stigma length maximum value | Shorter or longer than 0.3 mm |
| C22  |                           | Shorter or longer than 0.5 mm |
| C23  | Stigma width maximum value | Shorter or longer than 0.25 mm |
| C24  | Stigma width minimum value | Shorter or longer than 0.15 mm |
| C25  |                           | Shorter or longer than 0.25 mm |
| C26  | Sepal length maximum value | Shorter or longer than 1.5 mm |
| C27  | Sepal length minimum value | Shorter or longer than 1 mm  |
| C28  | Sepal width maximum value | Shorter or longer than 1 mm  |
| C29  | Sepal width minimum value | Shorter or longer than 0.8 mm |
| C30  | Petal length maximum value | Shorter or longer than 2.5 mm |
| C31  | Petal length minimum value | Shorter or longer than 2 mm  |
| C32  | Petal width maximum value | Shorter or longer than 1 mm  |
| C33  | Petal width minimum value | Shorter or longer than 1.6 mm |
| C34  | Stamen length maximum value | Shorter or longer than 0.8 mm |
| C35  | Stamen length minimum value | Shorter or longer than 2 mm  |
| C36  | Stamen width maximum value | Shorter or longer than 1.5 mm |
| C37  | Seed length maximum value | Shorter or longer than 2 mm  |
| C38  | Seed length minimum value | Shorter or longer than 2.5 mm |
| C39  | Seed width maximum value | Shorter or longer than 1 mm  |
| C40  | Seed width minimum value | Shorter or longer than 0.8 mm |
| C41  |                           | Shorter or longer than 2 mm  |
| C42  |                           | Shorter or longer than 2.5 mm |
| C43  |                           | Shorter or longer than 1.5 mm |
| C44  |                           | Shorter or longer than 2 mm  |
| Code | Description                                      | Value                              |
|------|--------------------------------------------------|------------------------------------|
| C44  | Seed width minimum value                         | Shorter or longer than 1 mm        |
| C45  | Basal leaves length minimum value                | Shorter or longer than 15 cm       |
| C46  | Basal leaves width minimum value                 | Shorter or longer than 4 cm        |
| C47  | Basal leaves pedicel length minimum value        | Shorter or longer than 4 cm        |
| C48  | Plant length maximum value                       | Shorter or longer than 50 cm       |
| C49  | Life time                                        | Perennial or not                    |
| C50  | Habitus                                          | Erect or not                        |
| C51  | Single stemmed or not                            |                                    |
| C52  | Many stemmed or not                              |                                    |
| C53  | Plant surface                                    | Basal part naked or not             |
| C54  | Upper part naked or not                          |                                    |
| C55  | Plant waxy or not                                 |                                    |
| C56  | Swelling nodes existence                         | Present or absent                   |
| C57  | Petiole remains existence                        | Present or absent                   |
| C58  | Basal leaves shape                               | Lyrate basal leaves present or absent|
| C59  | Pinnatisect basal leaves present or absent       |                                    |
| C60  | 2–pinnatisect basal leaves present or absent     |                                    |
| C61  | 3–pinnatisect basal leaves present or absent     |                                    |
| C62  | Lanceolate basal leaves present or absent         |                                    |
| C63  | Ovate basal leaves present or absent             |                                    |
| C64  | Linear basal leaves present or absent            |                                    |
| C65  | Lanceolate basal leaves present or absent         |                                    |
| C66  | Cauline leaves shape                             | Pinnatisect cauline leaves present or absent|
| C67  | 2–pinnatisect cauline leaves present or absent    |                                    |
| C68  | Lanceolate cauline leaves present or absent       |                                    |
| C69  | Ovate cauline leaves present or absent            |                                    |
| C70  | Leaves surface                                   | Both surface has trichome or not    |
| C71  | Glabrous above has trichome below                |                                    |
| C72  | Stipul existence                                 | Present or absent                   |
| C73  | Sepal center color                               | Purple or yellow                    |
| C74  | Sepal margin color                               | White or yellow                     |
| C75  | Sepal surface                                    | Glabrous or not                     |
| C76  | Petal color                                      | White or yellow                     |
| C77  | Stamen position                                  | Equal or not                        |
| C78  | Stamen number                                    | 2 or not                            |
two types of numerical analyses were performed using NTSYS–pc 2.1 software (26). The first analysis was the Clustering Analysis (CA) and the second analysis was the Principle Components Analysis (PCA).

RESULTS

The result of the CA is the UPGMA (Unweighted Pair–Group Method using Arithmetic Averages) dendrogram (Figure 1).

The UPGMA dendrogram explains the numerical relationships of the taxa studied. According to the results; *L. sativum* ssp. *sativum* and *L. sativum* ssp. *spinescens* are the closest pair of taxa. *L. spinosum* is grouped with these two taxa and *L. campestre* is the closest species to the group. *L. lyratum* and *L. graminifolium* are the second closest pair of taxa and related to *L. latifolium*. These taxa are grouped with *L. ruderale* and *L. virginicum*. The third closest pair of taxa are *L. caespitosum* and *L. pumilum*, which are grouped with *L. cartilagineum*.

PCA analysis results were coherent with the CA analysis (Figure 2). According to PCA analysis *Lepidium sativum* subsp. *sativum* and *L. sativum* subsp. *spinescens* the closest studied taxa and these taxa were grouped with *L. campestre* and *L. spinosum*. *L. lyratum* and *L. graminifolium* showed a close relation again and these taxa are grouped with *L. ruderale*, *L. virginicum*, *L. latifolium* like they were grouped in UPGMA dendrogram. *L. caespitosum*, *L. pumilum* and *L. cartilagineum* were also grouped. *L. pumilum*
has an equal distance from L. caespitosum and L. cartilagineum. The pictures of the studied taxa are given in Figures 3-5.

PCA analysis reduces numerous characters to a few number components. Table 3 shows the component’s Eigen value and percentage of Eigen value. Eigen vector values of the first 4 components are given in Table 4. The first two components explain 39.61% of the total variation. According to the results of PCA analysis, the first five most effective characters describing the first component are seed length, the habitus of plant, the minimum and maximum length of sepal, and septum length. The first five most effective characters describing the second component are the seeds with or without wings, the presence of swelling leaf residues on the base of the plant, the length of the pedicel, the presence of the plant with a single stem, and the length of the septum.

**DISCUSSION**

L. spinosum, L. sativum ssp. sativum and L. sativum ssp. spinescens taxa (Figure 3) are clustered in this study and are placed in the section Lepiacardamon in classical systematic studies (7). According to the Flora of Turkey (7) L. campestre, the only taxon representing the section Lepia, is the closest species to the section Lepiacardamon (Figure 3). The dendogram results are compatible with classical taxonomic data in this respect.

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Figure 2. Position of studied taxa on the first two components.

Figure 3. A) L. campestre, B) L. spinosum, C) L. sativum subsp. sativum, D) L. sativum subsp. spinescens.
L. sativum is grown as a cultivated plant in many parts of the world. Therefore, it is not easy to draw the boundaries of its geographical distribution. There are different taxonomic approaches in terms of intraspecific classification with the effect of this situation. The species has two subspecies according to the Flora of Turkey and Flora of Iraq (7,27). In Flora of West Pakistan, the taxonomic level is defined as a variety, not a subspecies (28). According to the revision study conducted in Turkey, because of both the clarity of the morphological differences between the two taxa as well as due to differences in geographical dis-
## Table 3. Eigen value and percentage of Eigen value of components.

| Components | Eigen Value | Percentage of Eigen Value | Total Percentage Eigen |
|------------|-------------|----------------------------|------------------------|
| 1          | 21.6700     | 24.08                      | 24.08                  |
| 2          | 13.9788     | 15.53                      | 39.61                  |
| 3          | 10.8323     | 12.03                      | 51.65                  |
| 4          | 8.3728      | 9.3                        | 60.95                  |
| 5          | 6.4828      | 7.2                        | 68.16                  |
| 6          | 5.7569      | 6.39                       | 74.55                  |
| 7          | 4.9996      | 5.55                       | 80.11                  |
| 8          | 4.4561      | 4.95                       | 85.06                  |
| 9          | 4.1067      | 4.56                       | 89.62                  |
| 10         | 3.7017      | 4.11                       | 93.74                  |
| 11         | 2.5988      | 2.88                       | 96.62                  |
| 12         | 1.7636      | 1.95                       | 98.58                  |
| 13         | 1.2713      | 1.41                       | 100                    |

## Table 4. Component’s Eigen vector value.

| B1   | B2   | B3   | B4   |
|------|------|------|------|
| C1   | 8.1577 | 1.7598 | 3.3445 | 7.6318 |
| C2   | 7.8622 | −3.1628 | 6.4978 | −1.6688 |
| C3   | 7.3615 | −5.525  | 7.1535 | −1.4991 |
| C4   | 8.1577 | 1.7589  | 3.3443 | 7.6318 |
| C5   | 7.4498 | −5.115  | −2.5845 | −1.7279 |
| C6   | 7.4498 | −5.115  | −2.5845 | 1.7279 |
| C7   | 8.1067 | 6.1259  | 2.8759 | −3.1068 |
| C8   | 7.0984 | −1.7069 | 2.2081 | −3.9225 |
| C9   | 7.2261 | −1.0386 | 2.8368 | 1.6263 |
| C10  | 5.1939 | −4.874  | 1.1398 | −1.064 |
| C11  | −1.3344 | 4.5014  | 4.2963 | −1.2953 |
| C12  | 3.1741 | 7.5122  | 4.2598 | 9.0736 |
| C13  | −6.4439 | 5.5676  | 3.7611 | −1.5546 |
| C14  | 1.3431 | 8.4926  | −1.4174 | −9.391 |
| C15  | 8.1577 | 1.7589  | 3.3443 | 7.6318 |
| C16  | 8.2272 | −5.4576 | 9.4618 | −2.5207 |
| C17  | 8.3823 | −7.2074 | 5.6088 | −1.4323 |
Table 4. Continue.

| C18  | 7.009 | -3.8102 | -1.0506 | -3.4768 |
| C19  | 7.528 | 4.4059  | 2.6295  | 2.6688  |
| C20  | 2.801 | -1.0181 | 1.4588  | -5.5078 |
| C21  | 7.528 | 4.4059  | 2.6295  | 2.6688  |
| C22  | 7.0941| 1.9486  | -6.6924 | -9.7554 |
| C23  | 5.9917| 5.0211  | -8.614  | 1.0578  |
| C24  | 1.3428| 3.1286  | -7.9831 | 3.6451  |
| C25  | -1.408| 5.7247  | 2.2524  | 3.4448  |
| C26  | 1.051 | 2.7864  | -7.0197 | 7.8805  |
| C27  | -3.313| 2.5432  | 2.5923  | 5.3754  |
| C28  | 8.5043| 2.5371  | -2.1567 | -2.4258 |
| C29  | 8.5043| 2.5371  | -2.1567 | -2.4258 |
| C30  | 5.5623| 5.869   | -1.042  | -2.678  |
| C31  | 1.3188| 6.2204  | -4.0622 | -3.1672 |
| C32  | 6.9054| 4.0033  | -4.6847 | 3.6139  |
| C33  | 3.789 | 2.8278  | -4.1131 | 5.3833  |
| C34  | 1.4221| 3.924   | -3.8543 | -1.9705 |
| C35  | 1.6754| 6.7856  | 3.7243  | -1.549  |
| C36  | -3.2513| 6.5742 | -1.7311 | 1.1972  |
| C37  | 6.5701| 2.4961  | -5.0581 | -2.4516 |
| C38  | 4.3287| 1.8748  | -4.5252 | 1.7334  |
| C39  | 8.7965| 2.9907  | 1.1786  | 1.425   |
| C40  | 5.6454| -4.5667 | 1.7145  | 3.261   |
| C41  | 8.1577| 1.7589  | 3.3443  | 7.6318  |
| C42  | 7.009 | -3.8102 | -1.0506 | -3.4768 |
| C43  | 8.1577| 1.7589  | 3.3443  | 7.6318  |
| C44  | 5.2255| 2.7924  | 3.5573  | -2.0302 |
| C45  | 4.4301| -1.7607 | -5.6159 | -5.091  |
| C46  | 3.8871| -6.922  | -5.1692 | 3.2119  |
| C47  | 3.5547| -2.0308 | -3.6233 | -5.4515 |
| C48  | -2.3959| -4.1107 | -4.2069 | -7.7936 |
| C49  | 4.0749| -7.3958 | 4.1262  | -2.0175 |
| C50  | 8.6528| 5.0179  | 5.8839  | -1.687  |
| C51  | -4.0749| 7.3958 | -4.1262 | 2.0175  |
| C52  | 4.7507| -6.8027 | 1.9056  | 7.5579  |
Table 4. Continue.

|    |     |     |     |     |
|----|-----|-----|-----|-----|
| C53| −1.3428 | −3.1286 | 7.9831 | −3.6451 |
| C54| 2.3881 | 5.057 | 4.4158 | −4.327 |
| C55| −2.9336 | 4.3552 | 4.4765 | −5.122 |
| C56| 4.0356 | 1.1781 | 2.8518 | 6.6462 |
| C57| 2.1608 | 8.7231 | 2.1741 | −1.0536 |
| C58| 4.4758 | 2.8737 | 2.4905 | 1.7616 |
| C59| −3.9602 | 5.3022 | −3.3933 | −2.2854 |
| C60| −1.2301 | 3.7383 | −2.8989 | −4.2022 |
| C61| 1.0647 | −4.7006 | −4.6956 | −5.4175 |
| C62| 2.8898 | −5.7685 | 5.0445 | 1.737 |
| C63| −4.8731 | −3.4476 | 1.8812 | 5.6061 |
| C64| −1.1663 | −4.6782 | 1.5965 | −4.2597 |
| C65| −1.4111 | −4.2019 | 8.2345 | 4.1765 |
| C66| −4.7657 | 2.5251 | 1.6425 | −7.5776 |
| C67| 7.7308 | −1.9457 | −5.1567 | −7.1191 |
| C68| −1.6978 | −1.2835 | 3.7654 | 5.2953 |
| C69| −1.0993 | −2.7311 | −4.7492 | 1.0636 |
| C70| 2.547 | 4.2819 | −2.3125 | 4.7474 |
| C71| −4.7657 | 2.5251 | 1.6425 | −7.5776 |
| C72| −2.6955 | −2.2652 | −4.9657 | 4.3641 |
| C73| −2.0825 | −3.9243 | 3.083 | 4.2735 |
| C74| 6.2841 | −1.307 | 5.8645 | 2.4181 |
| C75| 2.1569 | −2.6125 | 2.4595 | 1.6409 |
| C76| −2.2815 | −2.1394 | 6.5289 | 3.1386 |
| C77| 2.8233 | 2.3518 | −1.0312 | 6.119 |
| C78| 4.2576 | 3.0021 | −4.9163 | 8.3012 |
| C79| 2.0464 | 2.4789 | −3.6733 | 1.3125 |
| C80| −4.2576 | −3.0021 | 4.9163 | −8.3012 |
| C81| −6.4439 | 5.5676 | 3.7611 | −1.5546 |
| C82| −1.6183 | 6.0073 | 4.6361 | −6.1571 |
| C83| −2.3005 | −3.2699 | −3.0227 | −5.9666 |
| C84| 3.4683 | 3.9177 | 6.5477 | 2.8762 |
| C85| −3.4604 | 2.2105 | 1.0309 | 5.8767 |
| C86| −5.097 | −4.4255 | −5.8116 | −1.3273 |
| C87| −7.2798 | −1.711 | −5.8173 | −3.1014 |
| C88| 2.4089 | −6.9602 | 3.6955 | 7.2506 |
| C89| −5.0479 | −9.7737 | 6.1954 | 1.0801 |
| C90| −5.9977 | −1.4795 | 2.0557 | 3.4321 |
tribution seen between populations, it is stated that the definition should be at the subspecies level. In the Turkey Plant List (Vascular Plants), both subspecies and varieties are listed as a synonym and *L. sativum* is shown as a single species (22). The results of this study support the view that the *L. sativum* species should be better evaluated as two subspecies.

*L. latifolium*, *L. lyratum*, and *L. graminifolium* (Figure 4) are placed together in section *Lepidium* (7). These species also formed a group in this study and numerical results support the sectional classification. *L. ruderale* and *L. virginicum* (Figure 5), the closest species to the group according to the numerical analysis, are also placed in section *Dileptum* in the Flora of Turkey (7,9).

The last group comprises *L. caespitosum*, *L. pumilum* and *L. crassifolium*. *L. caespitosum* (Figure 5) was evaluated as an endemic species in the Flora of Turkey (7). According to Flora of Turkey (7), *L. pumilum* and *L. crassifolium* were represented as two subspecies; *L. cartilagineum* (J. May.) Thell. subsp. *cartilagineum* and *L. cartilagineum* (J. May.) Thell. ssp. *crassifolium* (Walldst. & Kit.) Thell. Later, Hedge (29) again accepted them as two subspecies but with a new combination. In the Flora of the USSR, they are accepted as separate species (30). These three taxa were listed as subspecies of *L. cartilagineum* by Mutlu (22) while the revision of Turkish *Lepidium* proposed they must be considered as different species (24). Numerical analysis results in this study support the idea of evaluating these three taxa as separate species. It also shows that *L. pumilum* is closer to *L. caespitosum* than to *L. cartilagineum*.

There is a tendency for some of the flower parts to be reduced to the point of absence, and hence flower structure is used in the subgeneric classification in the genus *Lepidium* (31). Flower structure and the characters of vegetative morphology are used in species identification in the genus *Lepidium* (32,33). The results of PCA analysis support the idea that the habitus of plant, the minimum and maximum length of sepal, the presence of swelling leaf residues on the base of the plant, and the presence of the plant with a single stem are important characters.

It has been reported that seed characters tend to have been ignored in *Lepidium*, with the exception of trifid cotyledon of *L. sativum* (31,33). However, the results of the present study showed that seed length, septum length, and the eventual presence and features of the seed wing are diagnostic characteristics for the genus *Lepidium*. This result is coherent with studies using seed characteristics for taxonomic studies in *Lepidium* (31,34,35).

Numerical analysis of *L. sativum* based on 21 morphological traits was performed based on Iranian specimens (36). According to that analysis, the first principal component analysis explained 63.0% of the total variation present in the dataset, besides that, petal length and sepal length and width had the highest positive correlation in PCA analysis (36). The present PCA analysis also shows that the sepal and petal length are two important characteristics that explain the first two components.

**CONCLUSION**

Numerical analysis studies based on morphological data on *Lepidium* taxa growing in Turkey is a useful tool for solving the taxonomic problems of taxa belonging to the genus *Lepidium*. This study gave significant results as the first step towards more comprehensive studies including more taxa.

**Proposed Treatment for Turkish *Lepidium* L. taxa**

**Section Lepia** (Desv.) DC.
1. *L. campestre* (L.) Aiton, Hort. Kew. ed. 2, 4: 88 (1812).
2. *Section Lepiocardamon* Thell.
3. *L. spinosum* Ard., Animad. Specim. Alt. 2: 34, t. 16 (1764).
4. *L. sativum* L., Sp. Pl. 2: 644 (1753). subsp. *sativum*
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6. *Section Dileptum* DC.
7. *L. ruderale* L., Sp. Pl. 2: 645 (1753).
8. *L. virginicum* L., Sp. Pl. 2: 645 (1753)
9. *Section Lepidium* DC.
10. *L. perfoliatum* L., Sp. Pl. 2: 643 (1753)
11. *L. vesicarium* L., Sp. Pl. 2: 643 (1753)
12. *L. caespitosum* Desv. in J. Bot. Agric. 3: 165 & 178 (1815)
13. *L. pumilum* Boiss. & Bal. in Boiss., Diagn. ser. 2(6): 21 (1859)
14. *L. cartilagineum* (J. May.) Thell. in Vierteljahr. Naturf. Ges. Zürich, 51: 173 (1906)
15. *L. latifolium* L., Sp. Pl. 2: 644 (1753)
16. *L. lyratum* L., Sp. Pl. 2: 644 (1753).
17. *L. graminifolium* L., Syst. Nat. ed. 10, 2: 1127 (1759)

**Peer-review:** Externally peer-reviewed.

**Authors Contributions:** Concept: M.B.; Design: M.B.; Supervision: M.B.; Materials: M.B.; Data Collection and/or Processing: M.B.; Analysis and/or Interpretation: M.B.; Literature Search: M.B.; Writing: M.B.; Critical Reviews: M.B.

**Conflict of Interest:** The authors declare that they have no conflicts of interest to disclose.

**Financial Disclosure:** There are no funders to report for this submission.

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