

## MORPHO-ANATOMICAL INVESTIGATIONS ON *MOMORDICA CHARANTIA* L. (CUCURBITACEAE)\*

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### ABSTRACT

Wild and cultivated populations of *Momordica charantia* L. (Cucurbitaceae) are pantropical distribution in the world. The plant is known as “kudret nare” and “sarı kadak” in Kosovo and “kudret narı” in Turkey. Mature fruits of the species contain resin and momordicine and use as stomachic, emolient, wound healing and purgative. Detailed morpho-anatomical properties of *M. charantia* collected from Kosovo/Prizren were investigated in the present study.

**Keywords:** *Momordica charantia* L., Morphology, Anatomy

## *MOMORDICA CHARANTIA* L. (CUCURBITACEAE) ÜZERİNDE MORFO-ANATOMİK İNCELEMELER

### ÖZET

Dünyada *Momordica charantia* L. (Cucurbitaceae)'nin doğal ve kültürlü yapılan populasyonları pantropikal bir yayılışa sahiptir. Bitki, Kosova'da “kudret nare” ve “sarı kadak”, Türkiye'de “kudret narı” isimleri ile bilinir. Olgun meyveleri reçine ve momordisin içerir ve mideyi yumuşatıcı, yara iyileştirici ve pürgeatif olarak kullanılır. Bu çalışmada, Kosova/Prizren'den toplanan *M. charantia*'nin ayrıntılı morfo-anatomik özellikleri incelenmiştir.

**Anahtar Kelimeler:** *Momordica charantia* L., Morfoloji, Anatomi

### 1. INTRODUCTION

*Momordica* L. (Cucurbitaceae), an African-originated genus of about 40 species, occurs exclusively in the Old World except for *M. balsamina* L. and the often noxious weed *M. charantia* L. [1]. *M. charantia* plants are grown the tropical regions take in Amazonian basin, Africa, Asia, Caribbean islands, India, China, Malaysia and South America [2]. Wild and cultivated populations of *M. charantia* are pantropical in distribution. The species which is called as “balsam pear” or “bitter melon” is grown as an ornamental and vegetable crop. Although its native country is uncertain, the regions of eastern India and southern China have been suggested as possible centers of domestication [1]. The plant is known as “kudret nare” and “sarı kadak” in Kosovo [3] and “kudret narı” [4, 5] and “balsam apple” [6] in Turkey. Mature fruits of the species contain resin and momordicine and use as stomachic, emollient, wound healing and purgative [4]. Macerated mature fruits in olive oil or almond oil for 15 days under the sunlight used for the treatment of wounds, furuncles or eczema in Turkey. It is reported the pasta of crusted mature fruits in honey used for stomach and intestine ulcers [2]. Chloroform fraction of fruits showed anti-*Helicobacter* activity against the standard strain, with MIC value 31.2 µg/mL while the MIC values for two clinical isolates of *Helicobacter pylori* was 62,5 and 125 µg/mL (amoxicillin with 0,2 µg/mL and ofloxacin with 0,98 µg/mL) [7]. It was reported the plant extracts showed antiprotozoal activity against *Entamoeba histolytica* and *Trypanosoma brucei*. It is also reported the plant is hypoglycemic and used for reducing the blood glucose levels [2]. Detailed

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morpho-anatomical properties of *M. charantia* collected from Kosovo/Prizren were investigated in the present study.

## **2. METHOD**

Cultivated plant materials were collected from Kosovo/Prizren/Nashec village, September 2012. Voucher specimens were deposited in the Herbarium of Anadolu University, Faculty of Pharmacy Eskişehir (ESSE 14681). Macromorphological observations were carried out under a binocular stereomicroscope (Olympus SZX12 with drawing tube). Live materials were stored in 70% ethanol for anatomical studies. Cross sections of stem and stem sections were stained with, cross and surface sections of the leaves were made by hand and stained with Sartur solution. Binocular light microscope (Olympus BX51) and camera (Kameram 122CU) were used for taking photographs.

## **3. RESULTS**

### **3.1. Morphology**

Annuals, 3.42-1.15 m, climbing herbs, stem with scarcely covering hairs. Leaves alternate, simple, exstipulate, petiol 93-45 mm; reniform, 113-73 x 120-76 mm, cordate, palmatilobate, with 5-7 lobes, lobes sinuate, glabrous at upper surface, scarcely with covering hairs on the veins at the lower surface. Flowers born at leaf axils usually solitary, unisexual and with 5-merous. Female flowers petiol 33-26 mm, calyx green, tubulate, sepals 6-4 x 2-1 mm; petals 14-8 x 10-7 mm, brilliant yellow, stigma with 3 lobes; male flowers petiol 66-55 mm, calyx green, sepals 8-6 x 2-1 mm, petals 18-12 x 12-9 mm, free, obovate, yellow-orange, stamens 3 and with staminal colon. Fruits 128-70 x 62-37 mm, ovoid-ellipsoid, yellow-orange, a fleshy capsula, large tuberculate, stalk 37-28 mm. Seeds oblong, number in the fruit 24-41, 14-11 x 8-6 x 3-2 mm, white and with a sculptured testa (Figure 1, 2).

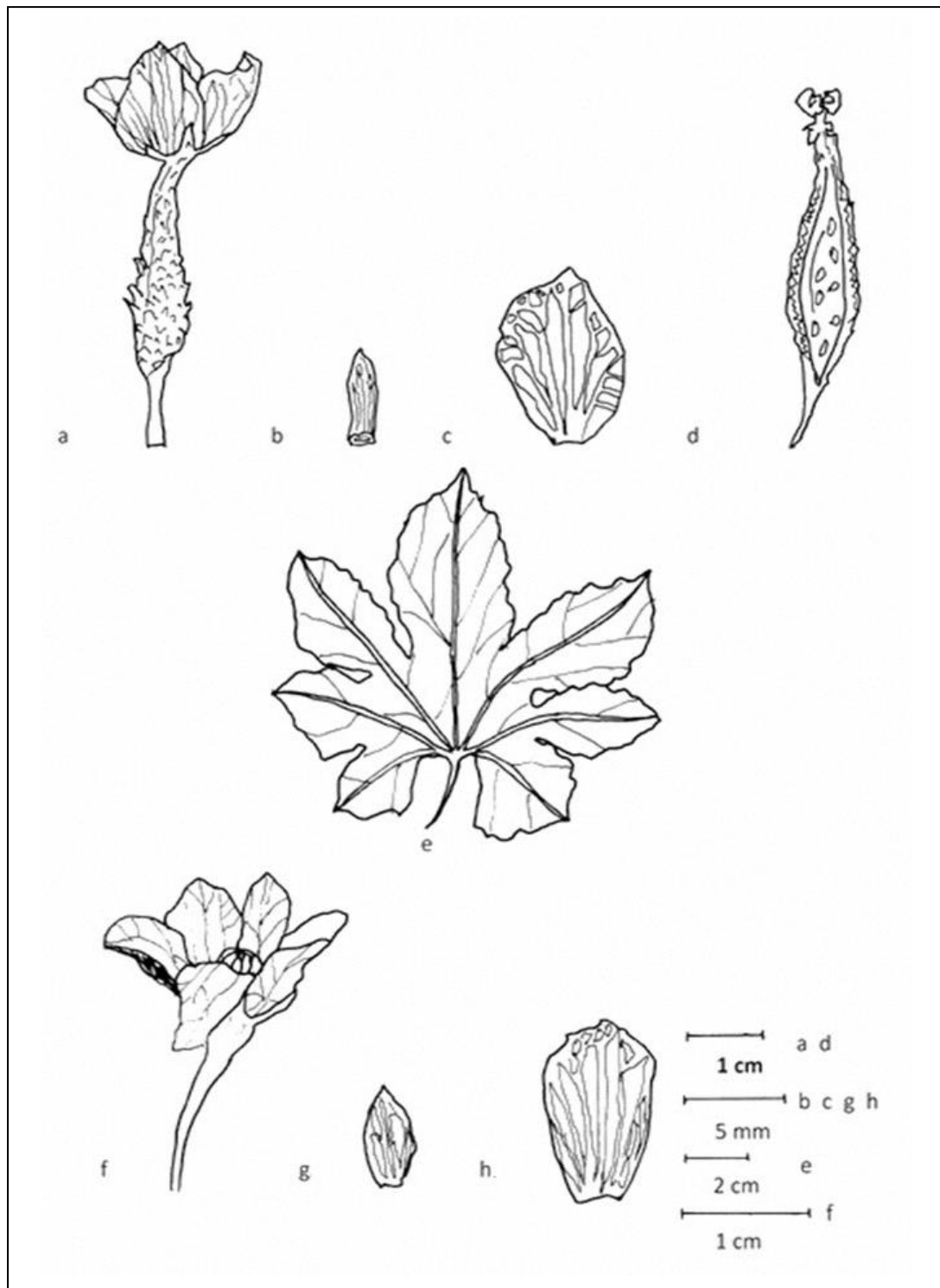
### **3.2. Anatomy**

#### **3.2.1. Stem**

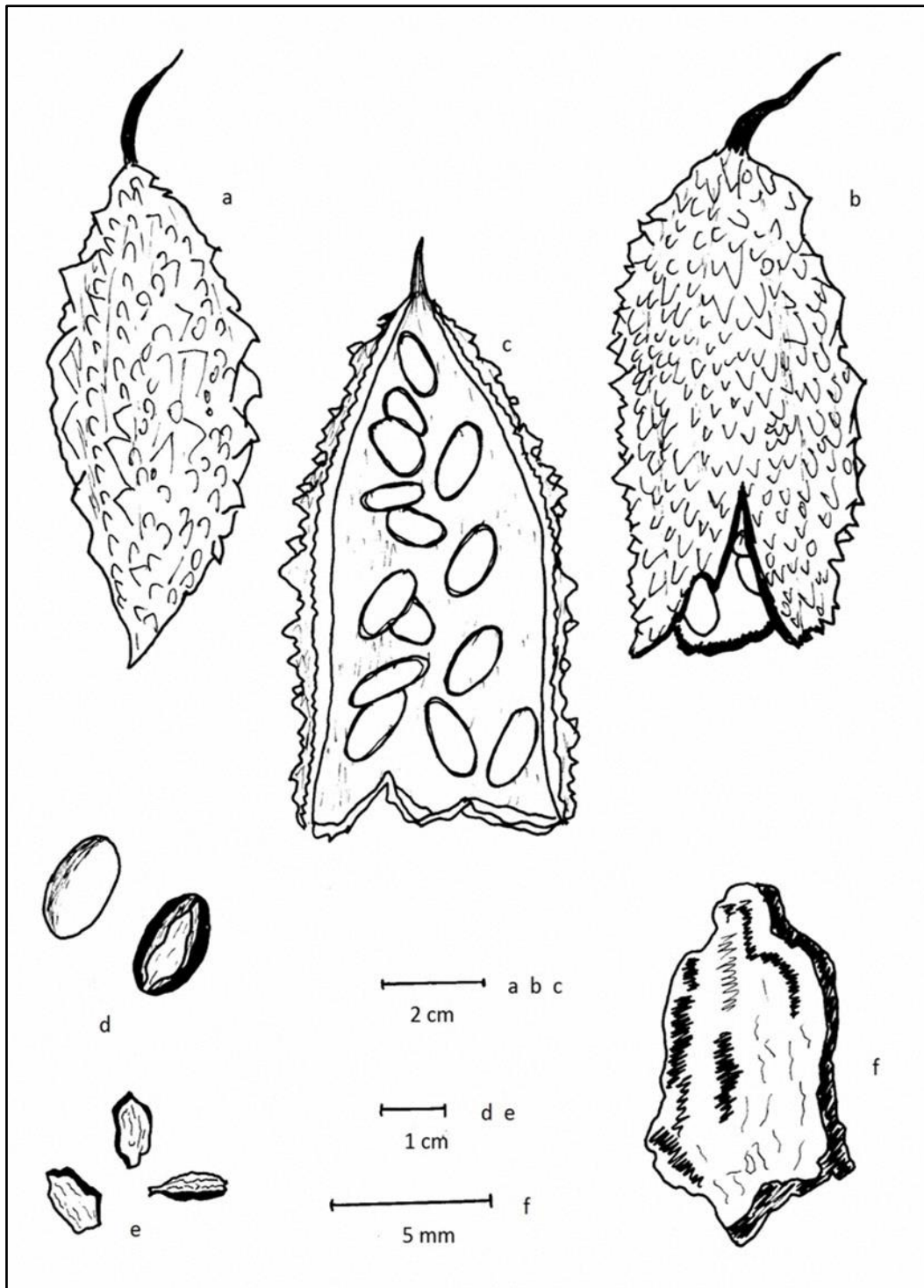
The stem is with five angles. The outermost anatomical tissue is epidermis and it is with thin and smooth cuticle. Below the cuticle, the epidermis is lying with one cell line. 6-8 cells lines of collenchyma at the corners of the stem are located (Figure 3A). After the 1-8 layered sclerenchyma, ten bicollateral vascular bundles are situated in two rings (the outer and the inner ones). Each ring is contained five bundles. Fibro-vascular bundles are located in each corner. Well-developed xylem is surrounded by outer and inner phloem. Inter-fascicular cambium is not clear, fascicular cambium slightly seen (Figure 3B). Bundles are separated by parenchymatic rays with prismatic crystals (Figure 3C). Pith is parenchymatic.

#### **3.2.2. Leaf**

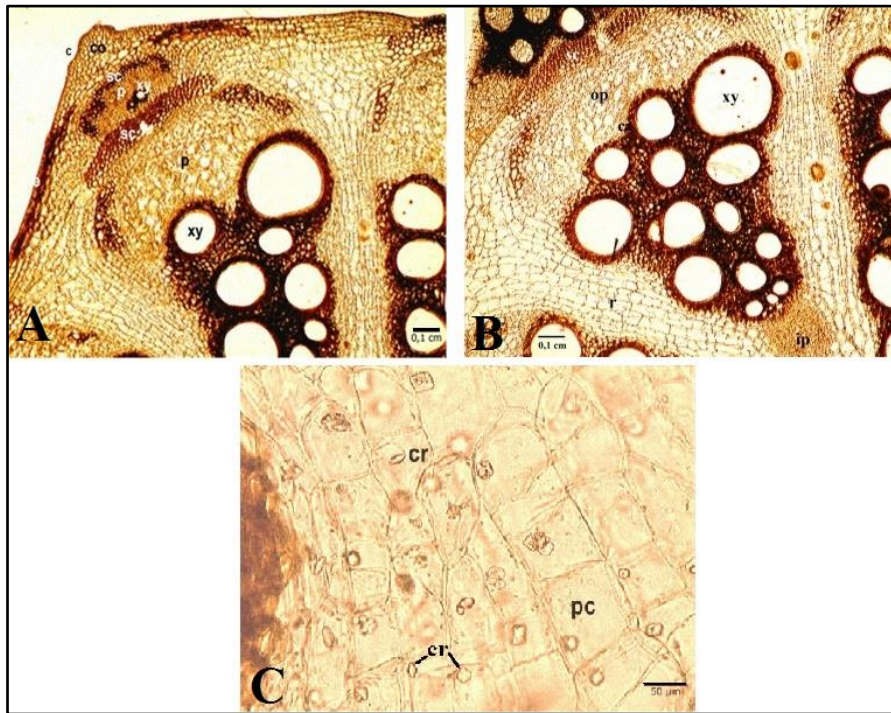
The midrib is distinct. Upper and lower epidermis are in a line the rectangle, ovoid cells. It is situated some collenchyma cells under the xylem (Figure 4A). Leaves are dorsiventral, palisade parenchyma cells are 1-2 layered, spongy parenchyma cells are 2-3 layered (Figure 4B). Stomata type are anomocytic (or ranunculaceous type) and taken apart on both surfaces (amphistomatic). Upper epidermis and lower epidermis cells are crinkly (Figure 5A, 5C). Lower epidermis cells have lots of double, triple and scarcely sested cystoliths (Figure 5B, 5D).



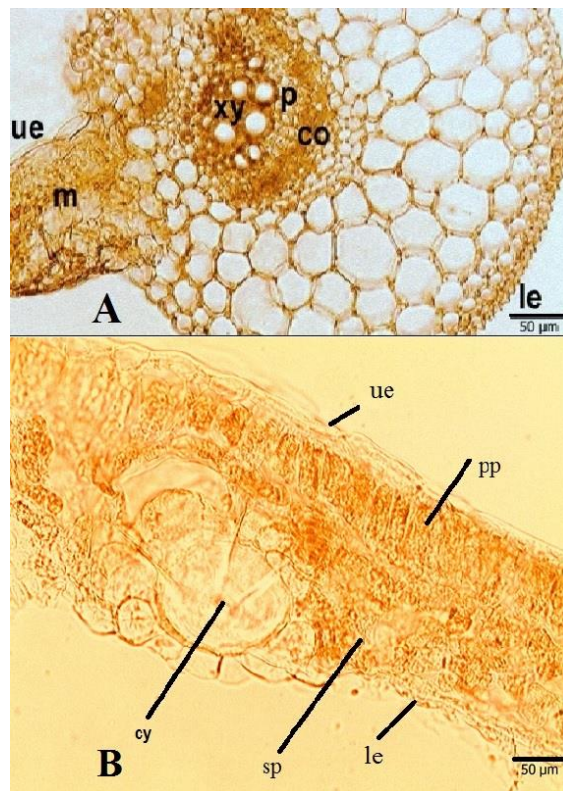
**Figure 1.** *Momordica charantia* L. (ESSE 14681). a. female flower (laterally), b. female flower sepal, c. female flower petal, d. female flower (longitudinally section), e. leaf, f. male flower (laterally), g. male flower sepal, h. male flower petal.



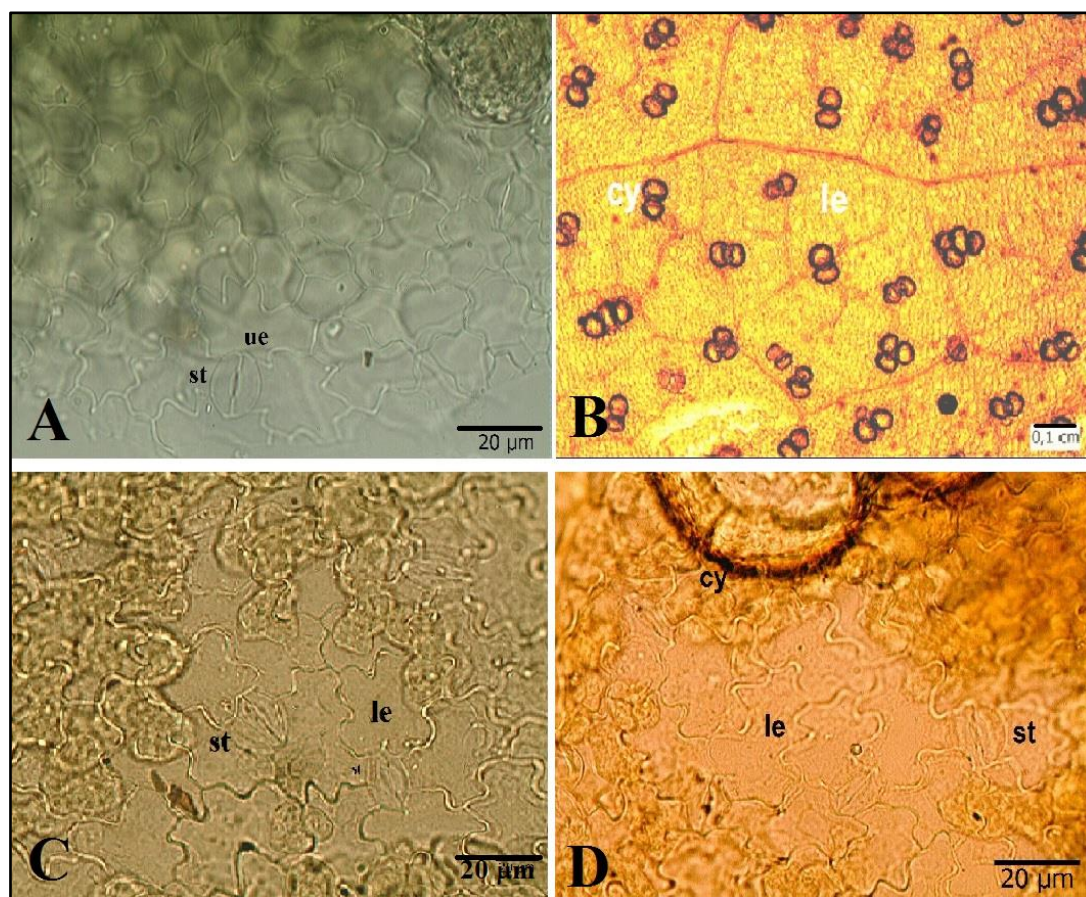
**Figure 2.** *M. charantia* L. (ESSE 14681). a. fruit, b. fruit (maturing), c. inside fruit, d. seeds (before maturing), e. seeds (after mature), f. seed.



**Figure 3.** *M. charantia* cross sections of stem (A, B) and parenchymatic ray with crystals between vascular bundles (C). e epidermis, c cuticle, co collenchyma, sc sclerenchyma, ca cambium, p phloem, op outer phloem, xy xylem, r ray, ip inner phloem, cr crystal, pc parenchyma cell of ray.



**Figure 4.** *M. charantia* cross sections of leaf midrib (A) and leaf mesophyll (B). ue upper epidermis, m mesophyll, xy xylem, p phloem, co collenchyma, le lower epidermis, pp palisade parenchyma, sp sponge parenchyma, cy cystolith.



**Figure 5.** *M. charantia* upper surface (A), lower surface (B, C, D). ue upper epidermis, le lower epidermis, cy cystolith, st stomata.

#### 4. DISCUSSION

Detailed morphological and anatomical properties of *M. charantia* are given in the present study. The plant was cultivated in Kosovo/Prizren. Descriptive morphological properties and leaf, female and male flowers and fruit drawings of the plant are given in this study. There is not detailed information on the genus *Momordica* or *M. charantia* species in the Flora of Turkey and the East Aegean Islands [6]. The species mentioned as “balsam apple” and determined as an annual climber with deeply lobed leaves, conspicuous green bracts median on the male flower-stalks, yellow flowers and orange-red, tuberculate fruits, is occasionally cultivated in gardens [6].

Cross sections of stem and upper and lower surface sections of the leaves were investigated. Stems were in five angles. The cuticle was thin and smooth. It was not observed any covering or secretory trichomes on the epidermis of the stem. Collenchyma developed only at the ridges. Each fibro-vascular bundles are comprised of outer phloem, xylem and inner phloem with a sclerenchyma line before the outer phloem. Secondary fibro-vascular bundles were situated under the collenchyma (Figure 3A, 3B). Ten bicollateral primary vascular bundles was seen in two line at the stem anatomy which are separated by parenchymatic rays bearing prismatic crystals (Figure 3C).

Yasuda [8] reported that the old stems of the species had sharply ridged angles and with conical covering trichomes blunt at apex and blunt ended glandular trichomes with an oval head consisting of one or more cells collected plants from Japan. The cuticle of the stem mostly thin and smooth;

collenchyma developed only at the angles; sclerenchyma is placed outward of each fibro-vascular bundles; primary fibro-vascular bundles bicollateral and arranged in two rings, the outer and the inner and each bundle contained five bundles and with well-developed xylem. Calcium oxalate crystals displaying various forms belonging to the quadratic system in the stem anatomy. The exception of trichomes existence, our outputs about stem anatomy corresponds to Yasuda [8].

Stem anatomy of Cucurbitaceae family members is determined as frequently angular, with collenchyma in the ribs; epidermis with stomata; cortex including collenchyma, especially in the ribs. The outer part of the cortex becoming interrupted during secondary thickening. Cork is not observed in many stems. Vascular bundles nearly always bicollateral and arranged in two, more or less distinct, circles. Xylem and phloem often become dissected by the formation of secondary rays produced by the fascicular cambium. The arrangement of vascular bundles in the internodes mentioned as five bundles in the outer and five in the inner circle in the genus *Momordica* [9]. The exception of the stomata on the stem epidermis, our results about stem anatomy supports to Metcalfe and Chalk [9].

It is observed that the leaves are dorsiventral, amphistomatic with anomocytic stomata and cystoliths on the lower surface. Gill and Karatela [10] reported that *M. charantia* from Nigeria had dorsiventral leaves with anomocytic stomata and bearing cystoliths on the leaf epidermis as also observed by us. They also mentioned with covering simple secretory hairs, two or four head cells, long or short stalks which could not observe by us.

Yasuda [8] reported that anatomical observations on the under-side of the blade characterized by having many enlarged cells, each of them contains a globular cystolith. The palisade parenchyma consists of (3)4-10 layered cells while spongy parenchyma consists of 2-6 layered cells. The upper surface of the midrib always raised into a ridge, where the collenchyma was well-developed only at the lower margins. The variations of the palisade and spongy parenchyma cell layers, investigated leaf anatomy data are similar with Yasuda [6]. Metcalfe and Chalk [9] reported about the leaf anatomy of *Momordica* species as: leaves usually dorsiventral, glandular hairs with uniseriate stalks and spherical or disc-shaped heads; stomata confined to the lower side or present on both surfaces and ranunculaceae (anomocytic); cystoliths presence was recorded for numerous genera and species while crystals infrequent in many genera and species. Defined anatomical identifications of the leaf are similar to Metcalfe and Chalk [9] except the presence of glandular hairs.

## 5. CONCLUSION

*Momordica charantia* L. (Cucurbitaceae) has a widely distribution all around the world and it is an important plant due to its ethnobotanical usages. Morphological and anatomical properties of *M. charantia* collected from Kosovo/Prizren is investigated. Morphological studies supported by morphometric measurements and drawings of male and female flowers, fruit, and seeds of the species. In anatomical studies, cross sections of stem and leaf, upper and lower surface sections of leaves were evaluated. The stems are owned typical anatomical properties of a climbing dicotyledon plant. The leaves are amphistomatic and a lot of cystoliths on the lower surface of leaves, stomata anomocytic and situated much more at the lower surface of leaves.

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