

Journal of Plant Protection and Pathology

Journal homepage: www.jppp.mans.edu.eg
Available online at: www.jppp.journals.ekb.eg

Morphological and Anatomical Studies of the Genus: *Monacha* (Gastropoda : Pulmonata) at Sharkia Governorate

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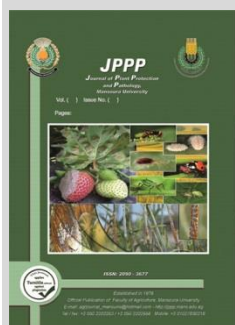


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ABSTRACT

This study was showed that different measurements of the shell and buccal mass (jaw and radula) of the gastropod genus *Monacha* sp. Which collected from five districts of Sharkia Governorate with different shell diameters included 10-10.9, 11-11.9, 12-12.9, 13-13.9 and 14 -14.9 mm. The snails with shell diameters 10-10.9, 11-11.9 and 12-12.9 mm were glassy color in all districts, while snails with shell diameters 13-13.9 and 14-14.9 mm were chalky color. Jaw was found crescent shape, pale to dark brown in color, transversely ribbed, number of ribs differed from shell diameter to another with general mean values of 15, 13.6, 12.8, 13.6 and 14 ribbon for shells 10-10.9, 11-11.9, 12-12.9, 13 -13.9 and 14-14.9 mm, respectively. Number of teeth columns and number of teeth in each row in radula of different shell diameters 10-10.9, 11-11.9, 12-12.9, 13-13.9 and 14 -14.9 mm were ranged between values (Fakous) (51:57) column, (105 : 137) teeth), (Hehia) ((49 : 63), (101 : 135)), (Belbies) ((50: 57), (107 : 128)), (Meniet-Elkamh) ((54 : 63), (112 : 148)) and (Kafr –Sakr) ((56 : 61), (115 : 146))., respectively in different localities. The total number of teeth calculated to formula in general mean of different shell diameter examined of *Monach* sp were 13724.48 teeth, 13660.32, 13043.80, 15929.4 and 15408.12 for shell diameter, 10-10.9, 11-11.9, 12-12.9, 13-13.9 and 14 -14.9 mm, respectively. Also rapprochement between number of teeth in both shell diameter of 10-10.9 & 11-11.9 mm and 13-13.9 & 14-14.9 mm.

Keywords: Morphology, gastropod, radula, jaw, shell shape, shell diameter, *Monacha* species, Egyptian clover.



INTRODUCTION

Land snails considered as a group of the most serious pests attacking agricultural crops around the world (Godan, 1983). The genus *Monacha* (Gastropoda, Hygromiidae) was classified into two species *i.e.* *Monacha cantina* (Montagu, 1803) and *Monacha cartusiana* (Muller, 1774) with a shell diameter and color of 16-18mm (yellowish) and 10-12mm (creamy milk-white) respectively (Godan, 1983). In Iraq, Abdul-Sahib (2006) recorded *M. obstructa* with a shell length of 14.3mm and the empty shells were creamy white and semicircular. Shell diameter of *M. obstructa* (Pfeiffer, 1842) ranged between 10-12mm with a cream-white color in Qatar and Lebanon (Al-Khayat, 2010 and Neubert & Bariche, 2013). However, *M. cartusiana* reached maturity at size of 8-10 mm in Greece (Staikou and Lazaridou – Dimitridou, 1990).

In Egypt at the beginning of the 20th century, the genus *Monacha* (Fitzinger, 1833) was first recorded as a species *M. obstructa* in Delta region (Pallary, 1925). For a long time the infestation was noticed to increase in new localities in Northern portion of Egypt, most injured crops were infested by *M. obstructa* (Kassab and Dauod, 1964). Moreover, EL-Deeb *et al.*, (1996) recorded *M. cartusiana* at Damietta Governorate. Ghamry *et al.*, (1993); Ismail, (1997); El-Masry, (1997); Mahrous, *et al.*, (2002) and Lokma, (2013) recorded *M. cartusiana* in different localities of Sharkia Governorate. Most researchers in Egypt identified species of the genus *Monacha* on the basis of measurement and shape of shell. However, there is a large varieties of species of genus *Monacha* and several

species remaining undescribed because of the lack of anatomical data so far (Neubert and Bariche, 2013).

The buccal mass has two main parts, jaw and radula. The shape of jaw and radula is utilized as main characteristic in Stylommatophorian taxonomy especially in identification (Soleme., 1978 and Barker, 1999). So, the main objective of this work is to get more information of the morphological parameters of the shell, jaw and radula of *Monacha* species in Sharkia Governorate.

MATERIALS AND METHODS

A: Morphological studies.

Samples of *Monacha* Sp. were collected from the clover (*Trifolium alexandirtum* L.) grown in one locality (village) at five districts in Sharkia Governorate, during April 2019. These districts were: Kafr Sakr (Abou-Nage), Meniet El-Kamh (El-Azezia), Hehia (ALAlakma), Fakous (Akiad El-Keblia), and Belbies (El-Tahawia). Each sample consisted of 50 adults individuals brought alive in plastic bags and sent to the laboratory. Shell diameter were measured by a Vernier caliper to nearest 0.02mm and divided to five categories according to shell diameter *i.e.* 10 –10.9 & 11 –11.9 & 12 –12.9 & 13 –13.9 and 14 –14.9 mm. Three replicates were randomly chosen from each shell diameter. Shell shape was determined and radula as well as jaw were extracted from each snail specimen. Shell diameter (SD), shell height (SH), spire index (SI), aperture diameter (AD) and color were recorded using a Vernier caliper to the nearest 0.02mm. The spire index (SI) was calculated by dividing the shell height (SH) by shell

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DOI: 10.21608/jppp.2021.154417

diameter (AD) according to Cain, (1977). The aperture area of the shell was represented by aperture height (AH) and aperture diameter (AD) according to Abdel-Rehim, (1983).

B: Anatomical studies.

To obtain the mouth parts (radula and jaw), head of the tested animals was cut and placed in a test tube containing 7.5% sodium hydroxide (NaOH). Tubes were heated in water bath for 10-15 minutes to clean the stuck tissues around the specimens, then washed with distilled water for ten minutes to remove the sodium hydroxide residues and after that neutralized in 15% acetic acid for 2-3 minutes. The radula and jaw were stained in diluted Mallory 2 containing of a mixture (aniline blue 0.5 gr + orang G 2.0gr + oxalic acid 2.0gr + distilled water 100ml) for about 3 minutes. Prior to staining, the solution was diluted as follows: 1 part Mallory 2 and 9 parts distilled water. The radula and jaw were put in 2% oxalic acid for 2 minutes and 96% ethyl alcohol for 3 minutes then washed in xylene. Finally, radula or jaw were transferred to a glass slide (teeth and jaw upwards) and mounted in Canada balsam medium (Frandsen, 1983). The magnifying power of microscope was 10x for jaw, and 40x for radula.

Length and width (mm), color, shape and number of ribs for each jaw were determined. Length and width (mm), of radula and number of marginal, lateral and central teeth were detected. Moreover number of lateral, central and marginal teeth in each row was also counted using a micrometer accurate to 0.01mm. Soft tissues were removed from the three replicate shells then washed in KOH and dried.

RESULTS AND DISCUSSION

A: Morphological studies.

1. Shell description of *Monacha* sp.:

Results revealed that aperture area of shells was differed from shell diameter to another in all districts with values ranged between (16.58 : 25.8), (25.85 : 27.89), (25.90 : 29.61), (31.37 : 37.78) and (37.08 : 43.62mm) in samples of shell diameter of 10-10.9, 11-11.9, 12-12.9, 13-13.9 and 14 -14.9 mm, respectively (Table 1). The general mean of both parameters i.e. aperture area and spire index of different shell diameters (10-10.9, 11-11.9, 12-12.9, 13-13.9 and 14 -14.9 mm) were (19.49±1.8, 0.58± 0.1), (27.06±0.072, 0.50± 0.11), (27.45±0.64, 0.49±0.004), (34.99± 1.16, 0.50±0.017) and (40.79± 1.45, 0.49 ± 0.004), respectively. The color of shell diameters 10-10.9, 11-11.9 and 12-12.9 mm was observed to be glassy in all different examined districts, while the color of the shell diameters 13-13.9 and 14-14.9 mm, was chalky. Generally, it could be conclude that as shell diameter increased aperture area was also increased, while the opposite was true for spire index. Results of correlation test clearly revealed in that there was a positive direct proportionality with shell diameter and aperture area, height of shell with value 0.9885 and 0.9222, respectively Table(2). While the negative inverse proportionality correlation was in spire index and shell diameter, shell height, aperture area with values -0.63011, -0.38414 and -0.73481, respectively. Mstat, version(1987).

These snails are considered as agricultural pests. They are morphologically closely similar to each other. Most Egyptian researches depended on color and diameter of shell for the identification of *Monacha* species. Godan (1983) described cartesian snail *M. cartusiana* (Muller) as follows -: shell diameter 10-12mm, shell height 6.5-7.5mm, depressed, globular, slightly translucent thin-walled milky white or creamy white, Whorls, rising in a flattened cone aperture elliptical rounded-crescentic. While the Kentish snail *M. cantiana* (Montagu) with shell larger, globular, less depressed 16-18 mmb, 11.3-12.5 mmh, 6-6.5 convex swollen in a low conical spire: yellowish-white, creamy-white, aperture nearly circular, spire: nearly circular, Staikou and Lazaridou-Dimitridou (1990) reported that *M. cartusiana* reached maturity at size (8-10 mm). In Iraq, Abdul-Sahib (2006) recorded the white land snail *M. obstructa* (Pfeiffer, 1842), where the shells length reached to 14.3 mm, where the empty shell was creamy white and semicircular. In Qatar (Al-Khayat, 2010) mentioned that *M. obstructa* had a smaller shell of 5-6 mm and diameter ranges averaged 10-12 mm with a cream white color and kept the identification in the Natural History Museum in London. Neubert and Bariche, (2013) found that the shell diameter of *M. obstructa*, was 11.89 mm, shell height 6.68 mm, peristome diameter 5.85mm. The shell small, cream white in color, aperture with thick white labial callus, umbilicus closed, forming a funnel shaped "pseudo-umbilicus".

B: Anatomical studies.

1. Description of the jaw of *Monacha* Sp.

The jaw was a single structure with a crescentic shape from pale to dark brown in color, transversely striated or ribbed, consisting of cuticular units extending parallel to each other (as shown in Table 1 and Fig 1).

It was found that number of ribbons differed according to shell diameter i.e. 10-10.9, 11-11.9, 12-12.9, 13-13.9 and 14 -14.9 mm at different localities in Sharkia Governorate. Generally, means of jaw length and width were found with the similar values (1.2, 0.4) mm, for all shell diameters (10-10.9, 11-11.9, 12-12.9, 13-13.9 and 14 -14.9 mm), respectively. Whereas values of ribos number were 10.0 ±1.23, 13.6 ± 0.4, 12.6 ± 0.68, 13.6 ±1.017 and 14.0 ± 0.32 ribos, respectively. The range of jaw ribos were 8:18 ribos.

Data in Table (2) Show correlation between shell diameter and ribos number of jaws were positive direct proportionality with value 0.765305. Discussing the jaw of land snail literature reports showed, for instances, Hyman (1967) In Gastropods, the jaw it is usually a curve from cuticle, transversely striated or ribbed being formed of a thickened part of the whole area. The jaw consists of cuticular entities, secreted by the under lying epithelial cells. Abdullah (1990) showed that the variation in size, strength and ribbing of the jaw is so great that no systematic importance could be attributed to its gross features. Abdel-Rehim *et al.* (1994) described the jaw of *Eobaina vermiculata* as a single curved structure, with a length ranging from 4-41mm, and width from 1.25-1.5mm.

Table 1. Morphological differences of shell shape, Jaw and Radula of *Monacha* sp. in some localities in Sharkia Governorate with variety of shell diameter

variable	Shell diameter																		
	10-10.9mm					11-11.9mm					12-12.9mm					Mean ± S.E.			
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5				
Shell	Diameter (mm)	10.11	10.14	10.10	10.02	10.16	10.10±0.024	11.16	11.14	11.06	11.15	11.10	11.12±0.019	12.12	12.18		12.10	12.16	12.12
	Height (mm)	6.04	6.04	6.04	6.06	5.7	5.98±0.069	6.04	6.04	5.16	6.06	5.16	5.69±0.217	6.14	6.06	6.1	6.08	6.11	6.09±0.014
	Aperture area	16.58	17.13	16.72	25.80	21.22	19.49±1.8	27.84	26.11	25.80	29.55	25.97	27.06±0.072	26.48	25.90	27.70	27.60	29.61	27.45 ± 0.64
	Spine index	0.59	0.59	0.59	0.60	0.54	0.58±0.011	0.51	0.54	0.48	0.50	0.48	0.50±0.011	0.50	0.49	0.50	0.48	0.50	0.49±0.004
	Color	glassy	Glassy	glassy	glassy	glassy	-	glassy	glassy	glassy	glassy	glassy	-	glassy	glassy	glassy	glassy	glassy	-
Jaw	Length (mm)	1.2	1.2	1.2	1.2	1.2	-	1.2	1.2	1.2	1.2	1.2	-	1.2	1.2	1.2	1.2	1.2	-
	Width (mm)	0.4	0.4	0.4	0.4	0.4	-	0.4	0.4	0.4	0.4	0.4	-	0.4	0.4	0.4	0.4	0.4	-
	Ribos number	8	8	8	13	13	10±1.23	13	15	14	13	13	13.6±0.4	15	13	12	11	12	12.6±0.68
	Length (mm)	2.4	2	2.6	2	2	2.2±0.13	2.4	2.2	2.2	2.2	2.2	2.2±0.04	3	2.4	2.2	2.2	2.4	2.4±0.15
	Width (mm)	0.8	0.8	1	0.8	0.8	0.84±0.04	1	0.8	1	1	1	0.96±0.04	1	0.6	1	1	0.92	0.90±0.078
Radula	Number of rows	57	57	61	53	51	55.8±1.74	58	48	63	56	63	57.8±2.77	54	54	57	50	57	54.4±1.29
	Number of teeth in row	137	136	117	121	105	123.5±6.037	135	126	127	101	107	119.2±6.47	128	128	127	107	115	121±4.28
	Number of lateral teeth	36	28	32	32	30	31.6±1.33	29	24	34	29	34	30±1.87	31	31	34	23	30	29.8±1.83
	Central teeth	1	1	1	1	1	-	1	1	1	1	1	-	1	1	1	1	1	-
	Number of marginal teeth	20	28	28	20	20	23.62±1.96	28	24	28	26	28	26.8±0.8	22	22	22	26	26	23.6±0.98

Table 1. continued.

variable	Shell diameter												S. D.	
	13-13.9 mm					14-14.9mm								
	1	2	3	4	5	Mean ± S.E.	1	2	3	4	5	Mean ± S.E.		
Shell	Diameter (mm)	13.06	13.01	13.19	13.03	13.03	13.07±0.033	14.08	14.02	14.13	14.10	14.09	14.08±0.018	1.63
	Height (mm)	7.14	7.01	6.74	6.12	6.18	6.63±0.21	7.04	7.18	7.06	7.13	7.09	7.1±0.025	0.057
	Aperture area	31.37	33.63	37.78	35.10	37.08	34.99±1.16	43	37.45	37.08	42.81	43.62	40.79±1.45	8.17
	Spire index	0.54	0.53	0.51	0.45	0.47	0.50±0.017	0.50	0.51	0.49	0.50	0.49	0.49±0.004	0.038
	Color	Chalky	chalky	chalky	chalky	chalky	-	chalky	Chalky	chalky	chalky	chalky	-	-
Jaw	Length (mm)	1.2	1.2	1.2	1.2	1.2	-	1.2	1.2	1.2	1.2	1.2	-	-
	Width (mm)	0.4	0.4	0.4	0.4	0.4	-	0.4	0.4	0.4	0.4	0.4	-	-
	Number of ribos	11	13	13	13	18	13.6±1.017	14	15	13	14	14	14±0.32	1.63
	Length (mm)	3	2.6	2.4	2.6	2.4	2.6±0.11	2.4	2.2	2.4	2.6	2.6	2.4±0.075	0.167
	Width (mm)	1.2	0.8	1	1.2	1	1.04±0.075	1	1	1	1.2	1.2	1.08±0.049	0.098
Radula	Number of rows	54	54	58	63	59	58.2±2.77	56	56	61	61	61	59±1.23	1.87
	Number of teeth in row	148	146	146	143	112	139±6.80	142	115	146	141	119	132.6±6.46	8.48
	Number of lateral teeth	29	28	31	34	34	31.2±1.24	31	31	34	34	34	32.8±0.74	1.23
	Central teeth	1	1	1	1	1	-	1	1	1	1	1	-	-
	Number of marginal teeth	22	28	26	28	24	25.6±1.17	22	24	26	26	26	24.8±0.8	1.36

Table 2. Correlation values between diameter of shell or highs ,aperture area- spire- index ,ribos number in jaw,(radula length, width, row number of teeth, teeth number in row, number of lateral and marginal teeth of different shell (10-10.9, 11-11.9, 12-12.9, 13-13.9 and 14 -14.9 mm) of *Monacha sp.*

Variables		Shell			Jaw		Radula				
		Diameter (mm)	Highest (mm)	Aperture area	Spire index	Ribos number of jaws	Length (mm)	Width (mm)	Row number of teeth	Teeth number in row	Lateral number of teeth
Shell	Highest (mm)	0.922223									
	Aperture area	0.988599	0.878501								
	Spire index	-0.63011	-0.38413	-0.73481							
Jaw	Ribos number	0.765305	0.475661	0.837236	-0.92803						
Jaw	Length (mm)	0.688422	0.675262	0.672904	-0.52996	0.506805					
	Width (mm)	0.966669	0.795049	0.970261	-0.70228	0.8741	0.626039				
	Row number of teeth	0.780208	0.611511	0.736887	-0.31368	0.633964	0.287494	0.85523			
Radula	Teeth number in row	0.789787	0.821279	0.707272	-0.21346	0.379617	0.828713	0.720479	0.640371		
	Lateral teeth number	0.602177	0.774556	0.50105	0.197264	0.011994	0.165243	0.468562	0.612928	0.612962	
	Marginal number of teeth	0.273615	-0.09296	0.305069	-0.41814	0.653577	0.014025	0.507891	0.656219	0.107304	-0.17022

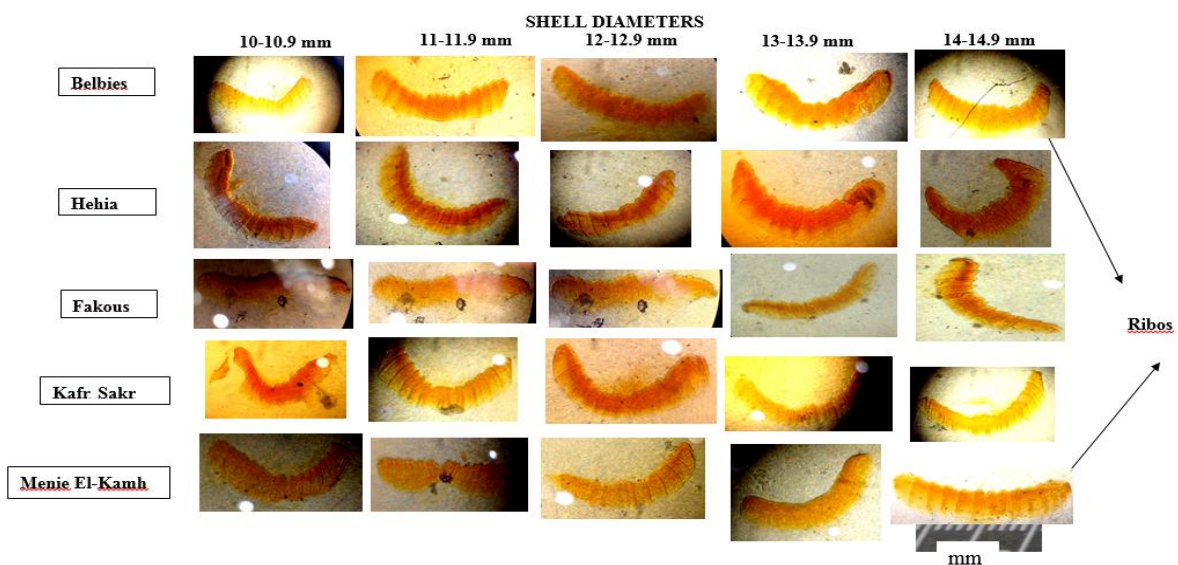


Figure 1. Jaw of *Monacha* species with different shell diameters (10-10.9, 11-11.9, 12-12.9, 13-13.9 and 14 -14.9 mm) collected from five districts in Sharkia Governorate.

It is composed of transversely striated cuticular units, ridges that vary in number from 4 to 6. Fouad (2002) mentioned that the jaw was smooth and contained thin prominent ridges for *Eobania vermiculata* and *Theba pisana* in juvenile period (2 months). In the adults, the jaws contained four prominent ridges for *E.vermiculata*, while containing three prominent ridges and one unapparent partially hide ridge for *T.pisana*. Abd EL-Wahab (2004) mentioned that the jaw of *Monacha cartusiana* has 15 ridges, and measures 1-1.2mm length and 0.23-0.25 width. Ali (2011) reported that the jaw of *M. cartusiana* is 0.81± 0.2mm long and 0.2 ± 0.08mm wide. It is nearly crescent shape, pale to dark brown, with elongate 11.18 ribos.

2. Description of Radula in *Monacha* Sp.

The radula teeth formula consists of three types of teeth including central, lateral and marginal teeth. The number and shape of the teeth transverse and longitudinal rows in snails, as different patterns can be used as adianostic characteristic to identify the snail's species.

It was found that the central tooth is rectangular with short and board cusp on both sides. The lateral teeth are rectangular in shape with lateral cusps Marginal teeth are oval with mesocone, endocone and ectocone. Fig (2)

Moreover, data in Table (1) showed that the length and width of radula were 2.2±0.13 (0.84± 0.04), 2.2± 0.04 (0.96±0.04), 2.4 ± 0.15 (0.90±0.078), 2.4 ± 0.07(1.08±0.049) and 2.6 ±0.11 (1.04±0.075) mm for shell diameters 10-10.9, 11-11.9, 12-12.9, 13-13.9 and 14 -14.9 mm, respectively. There are approachment between radula length in shell diameter 10.9, 11-11.9 and well between shell diameters 12-12.9, 13-13.9 down to increase shell diameter 14 -14.9 mm. It is also found to increase diameter of shell to increasing in radula width in 13-13.9 and 14 -14.9 mm. In Table (2) There are positive direct proportionality between radula (length and width) or row number of teeth and teeth number in row with values (0.267494, 0.85523) and (0.828713,0.720479) respectively.

Number of rows transverse of teeth in different districts(Fakous, Hehia, Belbies, Meniet-Elkamh and Kfr –Sakr)were ranged between (51 : 57), (49 : 63), (50 : 57) , (54 : 63) and (56 : 61) columns teeth for shell diameters (10-10.9, 11-11.9, 12-12.9 , 13-13.9 and 14 -14.9 mm), respectively .On the other hand, number of transverse teeth in each row were (105 teeth : 137), (101 : 135), (107 : 128), (112 : 148) and (115 : 146) teeth for different shell diameters (10-10.9, 11-11.9, 12-12.9, 13-13.9 and 14 -14.9

mm) respectively in different districts of Sharkia Governorate. The general mean of transverse row and number of teeth in row in radula for variety of shell diameter (10-10.9, 11-11.9, 12-12.9, 13-13.9 and 14 -14.9 mm) were (55.8±1.74 columns, 123.5±6.037 teeth) (57.8±2.77, 119.2± 6.47), (54.4±1.29, 121±4.28), (58.2± 2.77, 139±6.80) and (59± 1.23, 132.6±6.46) respectively.

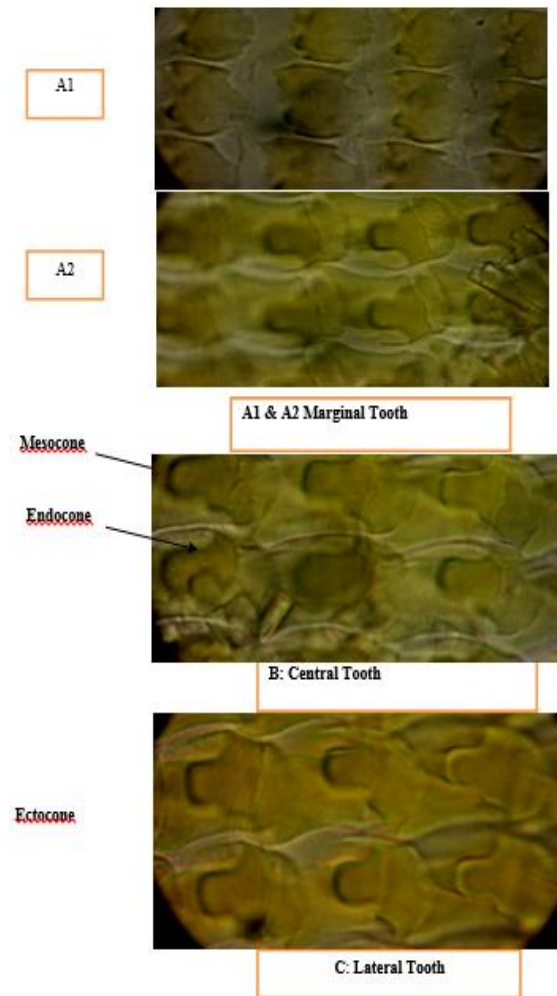


Figure 2. Central, lateral, marginal teeth in *Monacha Sp.*

The central teeth are with one transverse row. The lateral and marginal teethes were in different districts (Fakous, Hehia, Belbies, Meniet-Elkamh and Kafr – Sakr) were ranged between ((28: 36 teeth), (20:28)) ((24:34),(24:28)) ((23:34),(22:26)) ,(28:34),(24:28)) and ((31:34),(24:26)) teeth for shell diameter (10-10.9, 11-11.9, 12-12.9 , 13-13.9 and 14 -14.9 mm) respectively.

The general mean of the teeth formula for different shell diameters of *Monacha Sp.*were: (31.6 + 21.6 + 1 + 21.6 + 31.6) x 123.2, (30 + 26.8 + 1 + 26.8 + 30) x 119.2 (29.8 + 23.6 + 1 + 23.6 + 29.8) x 121, (31.2 + 25.6 + 1 + 31.2 + 25.6) x 139, (32.8 + 24.8 + 1 + 24.8 + 32.8) x 132.6 for shell diameter (10-10.9, 11-11.9, 12-12.9 , 13-13.9 and 14 -14.9 mm) respectively. The total number of calculated teeth of formula in the examined shell diameters were with values 13724.48, 13660.32, 13043.80, 15929.4 and 15408.12 teeth for shell diameters 10-10.9, 11-11.9, 12-12.9 , 13-13.9 and 14 -14.9 mm respectively.

There are approachment between total number of teeth in shell diameter 10.9, 11-11.9mm with glassy color

of shell and by increase shell diameter,13-13.9 and 14 - 14.9 mm. The shell color were chalky. Data in Table (2) show of correlation between shell diameter and row numbers of teeth, teeth numbers in row, lateral, marginal teeth were positive direct proportionality with values 0.780208, 0.789787, 0.602177 and 0.273615.

These dimensions mentioned by Mersal (1990) showed that in adult snails of *Eobania vermiculata*, radula ranges from 4.9 to 6.5mm in length and 1.7 to 2.9mm in width. The radula ribbon is formed of 180 transverse rows. Each row consists of 101 to 113 colorless and glassy teeth, a central or rachidion, 40-60 laterals (20 – 23 on each side) and 60-66 marginal (30 – 33 on each side) the lateral teeth are longer and narrow than the central tooth. The marginal teeth are completely different from lateral ones by the presence of amore develop endococones. Abel-Rehim *et al.* (1994) found that the radula of *Eobania vermiculata* contains numerous, small and simple teeth exhibiting each row. The length is 4.63mm and width is 1.9mm. The transverse row (the length is 4.63mm and width is 1.9mm) the transverse row formula (dental formula) of the radula is (29 + 28 + 1 + 28 + 29) x 135, with 29 marginal teeth and 28 lateral teeth on both sides and a central tooth, and all arranged in 135 rows. The central tooth is rectangular, with two short and broad cusps on both sides the lateral teeth are rectangular, with one lateral cusp, and another reduced one. The marginal teeth are rectangular, each with three cusps, a central round one, and two lateral needles like cusps. Barker (1999) showed that the buccal mass has two main parts beside a main formula of radula for each gastropod species, the shape of jaw and radula is utilizing as main characteristic in Stylommatophora taxonomy, especially in identification. Mackenstedt, U. and Markel, K. (2001) mentioned that each row of radula teeth consist of one central or median tooth, which called rachidion tooth or rachis tooth, more lateral teeth in each side, and beyond those more marginal teeth. Abd El-Wahab (2004) mentioned that the radula formula of *M.cartusiana* is (24 + 12 + 1 + 12 + 24) x 116. The central tooth is rectangular shaped with arrow head, while the lateral tooth is with triangular shape. Ali (2011) revealed that the radula of *Monacha cartusiana* averaged 2.3±0.44mm long, and 0.45±0.097mm wide. It is ribbon formed of 170.0 ± 18.99 transverse rows with 66.5 ± 10.96 teeth in row. The formula of *M. cartusiana* is (10 + 15 + 1 + 15 + 10) x 170.

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