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BIOCHEMICAL COMPOSITION OF THE SQUID (LOLIGO VULGARIS) (MOLLUSCA) FROM THE MEDITERRANEAN WATERS OFF ALEXANDRIA, EGYPT

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التركيب البيوكيميائي للرأسقوميات (لوليجو فولجارس) (رخويات) في مياه البحر المتوسط أمام سواحل الإسكندرية جمهورية مصر العربية

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الملخص العربي

لقد أجرى تحليل لمحتويات الجسم من الماء والبروتين والدهون والرماد لنوع من الرأسقوميات (لوليجو فولجارس) في مياه البحر المتوسط أمام سواحل الإسكندرية بجمهورية مصر العربية، وخلال الفترة من نوفمبر ١٩٨٩ وحتى أغسطس ١٩٩٠.

وقد أوضحت نتائج الدراسة أنه لا يوجد اختلاف جوهري في التركيب البيوكيميائي بين الذكور والإناث. وقد وجد أن المحتوى المائي قد ازداد في فصل الربيع وبداية الصيف. أما محتوى الجسم من الدهون فقد ازداد في أواخر الصيف وحتى نهاية الخريف ثم بدأ في التناقص خلال فصلي الشتاء والربيع. أما عن المحتوى البروتيني فقد أظهر أقل قيم له في الخريف والشتاء ثم بدأ في الازدياد التدريجي في فصل الربيع، في حين لم تكن هناك علاقة معينة بين محتوى الجسم من الرماد وشهور العام المختلفة. وقد تمت مناقشة العلاقة بين التركيب البيوكيميائي وكل من الظروف البيئية وموسم التزاوج خلال الدراسة.

Key words: *Loligo vulgaris*, body composition, protein, lipid, ash, Mediterranean Sea, Egypt.

Running title: Body composition of *L. vulgaris*

ABSTRACT

The seasonal biochemical variations of the squid *Loligo vulgaris* from the Egyptian Mediterranean waters off Alexandria were studied during November 1989 through August 1990. Water, lipid, protein and ash contents were determined in the mantles of 353 individuals representing a wide range of sizes of both males and females. Average monthly values of these parameters in both sexes followed approximately the same trends. An increase in body water was noticed in spring and early summer. Maximum mantle lipid values were recorded during August-November and minimum values in December-July. Lipid contents were positively correlated with mantle length except in summer where a negative correlation was found. A clear reverse relationship between water and lipid contents was evident. Protein contents were minimal during autumn and winter and showed an increase in spring and early summer. Ash contents of males and females showed irregular patterns. The relationships between body composition and animal size was discussed. The seasonal variations in those compositions in relation to gonads developments were also discussed.

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INTRODUCTION

Cephalopoda is an important classes of phylum mollusca. It includes more than 1,000 species, representing about 2% of the phylum [1]. The high nutritive value and increased demand for cephalopods has attracted the attention to their fisheries in recent years. As a result, world supply of cephalopods was increased from 6.6% of total fisheries landing in 1981 to 8.3% in 1990 [2] with total landing of 9.4 x 10^6 metric tons [3]. Meanwhile, squids represent the highest percentage of cephalopod commercial landing (71.8%) followed by octopuses (14.6%) and cuttlefish (13.6%) [3]. Twenty-nine cephalopod species have been recorded in the Mediterranean Sea [4]. Cephalopod catch represents about 10% of the total annual landing from the Egyptian fisheries [5]. However, limited information is available on taxonomy, distribution, reproductive patterns, growth, feeding habits, behavior, and biochemical composition of the commercially important cephalopod species in the Egyptian waters.

The present study was carried out to investigate the biochemical compositions of the squid *Loligo vulgaris*, and the monthly and seasonal variations in these compositions in the Egyptian Mediterranean waters around Alexandria.

MATERIALS AND METHODS

The biochemical composition analyses were carried out on 353 individuals of *L. vulgaris* (147 males and 210 females) collected from Alexandria and Rosetta fish markets during September 1989 through August 1990. Monthly samples representing a wide range of sizes of both sexes were collected (Table 1). The mantle of each animal was measured, separated, weighed to the nearest 0.1 g, and frozen for subsequent biochemical analyses.

The proximate analyses of water, total protein, total lipids and total ash contents of each mantle were determined. Body water, lipid and ash contents were determined using standard AOAC (1980) methods [6]. Water content was determined by drying and weighing the preweighed mantle in a drying oven for 24 hrs. at 100°C. Total lipids were extracted using chloroform-methanol mixture (2:1, V:V) [7]. Ash content was determined by weighing and ashing a dry subsample of the mantle in a preweighed porcelain crucible in a muffle furnace for about 6 hrs at 700°C. Total protein was determined spectrophotometrically using a modified Lowry method [8, 9].

The results were subjected to one-way ANOVA to test the effects of time (month) on body compositions. The mean values were compared using student's t-test at p=0.05. Seasonal regression analyses between body components and mantle length were also conducted.

RESULTS AND DISCUSSION

The mean monthly percentages (on wet weight bases) of body composition of males and females *L. vulgaris* mantles followed similar patterns (Table 2). Therefore the relationships between mantle length and body compositions of males only were represented in Fig. 1. Water contents were significantly increased ($P<0.05$) during spring and early summer and decreased in autumn. Water content and mantle length were negatively correlated (Table 3) (except during summer, where a positive correlation was found). This indicated that immature and young animals contain higher water than mature ones.

Mantle lipid showed a significant increase in both males and females ($P<0.05$) in late summer through autumn (August-November). Lipid values were decreased and remained almost constant from December through July (Table 1). The increase in lipid content in late summer through autumn may have been a direct result of vigorous feeding following the spawning season (Spring and early summer). This increase could also be attributed to the effects of increasing water temperature and photoperiod in summer as has been demonstrated in other cephalopods [10, 11].

A positive correlation was found between body lipid and mantle length, except in summer where a negative correlation was noticed. It is clear, therefore, that body water and lipid contents in this species are negatively correlated. The inverse correlation between water and lipid contents has been documented in many marine animals [12-14].

The decrease in mantle lipid content with increasing mantle length during summer season may have been related to the mobilization of reserved body fat for gonads development in mature individuals, and/or consumption of body energy while fasting during spawning migration. Similar results were reported in *Loligo opalescens* [15] and *L. vulgaris* [16]. The mobilization of body fat for gonadal de-

Table 1

Monthly numbers and size ranges of *L. vulgaris* collected during the study

Month	Males			Females		
	No	Length range (cm)	Weight range (g)	No	Length range (cm)	Weight range (g)
Sept '89	12	13.2-17.7	50-110	12	32.5-47.0	45-190
Oct	--	--	--	--	--	--
Nov	5	19.5-22.5	175-240	3	18.0-19.5	145-155
Dec	42	8.2-28.3	15-360	26	10.3-20.1	25-170
Jan '90	14	13.2-26.2	80-260	44	10.5-22.0	40-170
Feb	33	10.6-37.3	35-530	16	14.8-23.8	95.245
Mar	17	12.1-33.5	55-455	35	7.5-22.7	15-270
Apr	7	13.4-31.8	55-465	31	8.7-24.0	20-270
May	--	--	--	--	--	--
June	--	--	--	--	--	--
July	7	14.2-23.0	70-240	9	12.9-19.3	55-165
Aug	10	8.7-22.0	20-245	34	8.0-22.0	20-245

velopment has also been recorded in the octopus, *Octopus tehuelchus* [17] and *O. octopus* [18].

Mantle protein content of *L. vulgaris* in the present study was significantly increased ($P<0.05$) in spring and early summer, followed by a decrease in autumn and winter. The decrease in protein content during autumn and winter may have been due to the decrease in feeding activity at low water temperature and/or the use of body protein as an energy supply during spawning migration, as has been reported in *S. officinalis* [19].

A positive correlation between mantle length and mantle protein was found in all seasons (Table 2). Such a positive correlation was observed in *Octopus vulgaris* [20], where protein synthesis increased with the increase in animal size. The ash contents of *L. vulgaris* showed irregular trends throughout the study.

Table 2

Average monthly values of water, lipid, protein and ash contents of *L. vulgaris*, on wet weight bases. Values in the same column with different superscript are significantly different ($P<0.05$).

Month	Water		Lipid		Protein		Ash	
	M	F	M	F	M	F	M	F
Sept '89	80.36^{a}	79.92^{a}	3.87^{a}	3.65^{a}	14.18^{a}	13.83^{a}	1.11^{a}	0.85^{a}
Nov	79.64^{a}	77.73^{b}	4.38^{a}	4.15^{b}	---	---	---	---
Dec	80.67^{a}	80.43^{ac}	3.04^{b}	2.93^{a}	14.94^{a}	15.89^{b}	0.96^{a}	0.94^{a}
Jan '90	80.38^{a}	80.32^{ac}	2.83^{b}	3.02^{a}	14.67^{a}	13.95^{a}	1.11^{a}	1.02^{a}
Feb	80.80^{a}	80.67^{ac}	3.05^{b}	2.89^{a}	14.00^{a}	14.30^{a}	0.83^{ab}	0.91^{a}
Mar	81.84^{b}	82.33^{d}	3.10^{b}	2.87^{a}	16.35^{b}	15.32^{b}	1.12^{a}	0.98^{a}
Apr	81.75^{b}	82.71^{d}	3.31^{b}	2.89^{a}	15.40^{ba}	14.23^{a}	1.21^{a}	1.07^{ab}
July	82.18^{b}	82.46^{d}	2.60^{c}	2.65^{a}	16.61^{b}	16.51^{bc}	1.29^{c}	1.28^{b}
Aug	81.19^{ab}	80.24^{ac}	3.75^{a}	4.69^{b}	13.20^{a}	13.54^{a}	1.11^{a}	1.18^{b}

No samples were collected in October, May and June.

Table 3

Seasonal linear regression analyses between mantle length (X) and body composition (Y) of *L. vulgaris*.

Component	Season	Linear equation					
		Males			Females		
		a	b	r^2	a	b	r^2
Water	Autumn	82.17	-0.118	0.96	84.65	-0.287	0.94
	Winter	82.93	-0.108	0.98	82.19	-0.104	0.94
	Spring	83.19	-0.069	0.98	86.51	-0.173	0.69
	Summer	81.02	0.039	0.94	78.55	0.162	0.94
Lipid	Autumn	3.29	0.052	0.96	2.95	0.051	0.96
	Winter	3.01	0.004	0.46	4.21	-0.074	0.96
	Spring	2.54	0.033	0.94	2.13	0.036	0.96
	Summer	5.15	-0.119	0.98	7.48	-0.240	0.98
Protein	Autumn	10.91	0.158	0.98	10.31	0.247	0.98
	Winter	13.51	0.061	0.96	14.09	0.004	0.52
	Spring	11.95	0.033	0.94	9.97	0.118	0.98
	Summer	12.38	0.099	0.98	13.18	0.043	0.67
Ash	Autumn	0.22	0.036	0.98	0.40	0.029	0.79
	Winter	0.79	0.009	0.94	0.74	0.014	0.98
	Spring	0.55	0.008	0.98	0.60	0.003	0.69
	Summer	0.66	-0.005	0.85	0.31	0.022	0.90

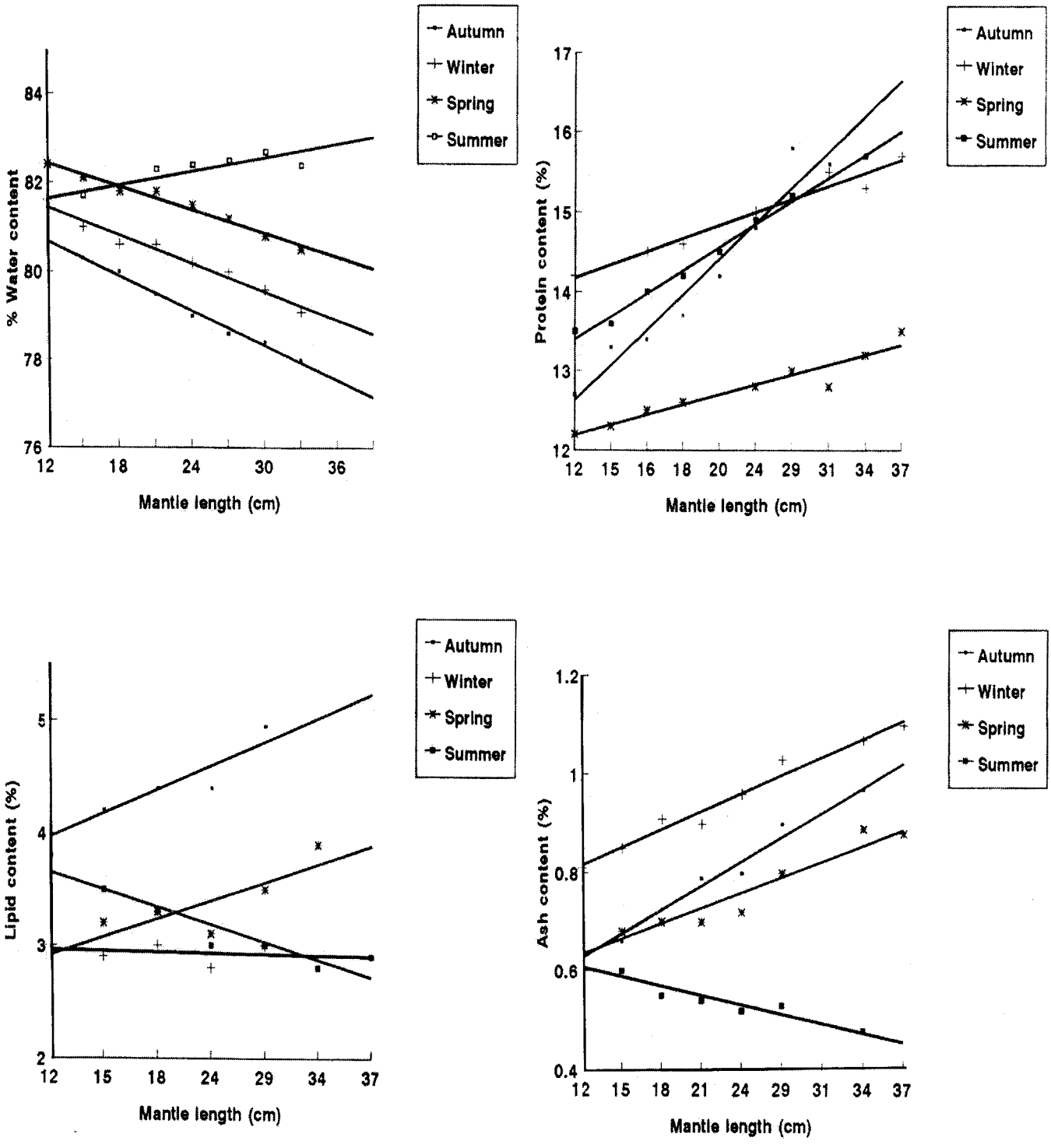

Fig. 1. The relationship between mantle length and body composition of *L. vulgaris* males.

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