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IODINE IN EGGS IN AN IODOPENIC REGION

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A b s t r a c t: Macedonia is a region with a recognized precarious iodine balance, due to iodine deficiency in almost all water sources. Five percent iodine intake through eggs in the daily diet of adults is significant in this balance. The content of 40–220 microg I/kg eggs is lower than the British one (average 340–370 microg I/kg). The amount per egg is 3–6 microg I far less than 711 microg I in special iodine-enriched eggs designed for treatment of thyroid and metabolic disorders by feeding chickens with kelp additives. The iodine content of our manufacturers, provides substantial part of former Yugoslavia with eggs, is entirely dependent on imported fishmeal in chicken feed.

Key words: iodine in eggs, iodine deficiency, iodine supplement.

Eggs and egg dishes contain iodine (I^-) and contribute about 5% of the total daily intake in adults (1). As an easy available and cheap protein product, eggs have an indispensable place in the total daily diet in this area, where other animal protein sources (meat and meat products, fish and fish products) are expensive. Animal protein is consumed to an important degree through milk and dairy products, particulary important in the diet of newborns and infants. The iodine supplied by milk and dairy products in the European population including adults is about 30% of the whole daily iodine intake (2). Macedonia is an area of precarious iodine balance due to elementary deficiency of iodine in almost all water sources (3), inclusive of animal and plantar foodstuffs dependent on water. Iodized salt (10 mgr KI/Kg NaCl) is, since 1956, compulsory (4) but iodine content in daily intake is still not adequate (5). It should be noted that sub-groups of our population (newborns and infants, pregnant women) may be at risk from low intakes of iodine (5). The contribution of eggs to iodine intake is important taking in consideration the paucity of iodine in our region. The results are presented in this paper.

Material and method

Collection of egg samples and preparation: eggs were collected from 14 egg-producing communal-owned farms and from private producers regularly bringing eggs to the market. A total of 71 eggs samples were examined. The shell of the fresh egg was broken, the content was homogenized and then analysed. Prepared samples were measured in duplicate after wet ashing in strong acid. Following that step, iodide was measured by its catalytic action on the reduction of ceric ion (Ce^{++}) to cerous ion (Ce^{3+}) coupled to the oxidation of arsenate (As^{3+} to As^{5+}). (6).

Table 1 – Табела 1

Iodine content in 71 egg samples collected from all communal specialized farms and private manufacturers from the market covering all export from Macedonia to neighbouring countries

	Source	Egg wieght	Egg net wieght	μg I^- per egg	μg I^- per kg
1.	Ovče Pole	61.4	52.9	3.43	64.84
2.	Ovče Pole	51.0	44.5	6.15	138.20
3.	Ovče Pole	54.3	47.0	6.24	132.77
4.	Ovče Pole	54.3	47.4	6.71	141.56
5.	Ovče Pole	66.1	57.1	5.82	101.93
6.	Ovče Pole	57.0	49.4	4.56	92.31
7.	Ovče Pole	52.4	45.6	6.71	147.15
8.	Ovče Pole	57.0	49.8	2.73	54.82
9.	Ovče Pole	56.4	48.7	3.55	72.90
10.	Ovče Pole	49.1	42.5	2.75	64.71
11.	Porodin	53.2	46.2	3.49	75.54
12.	Piskul	61.4	52.5	6.73	128.19
13.	Dolneni	59.5	51.6	6.38	123.60
14.	Dolneni	52.6	44.8	3.44	76.77
15.	Dolneni	67.6	59.8	3.98	66.47
16.	Dolneni	52.8	45.1	3.90	86.41
17.	s. Cumovo	57.5	49.9	22	4.44
18.	s. Stevica	60.0	51.3	14	2.81
19.	Štip	63.1	54.9	11.39	207.55
20.	Private	67.3	58.1	6.52	112.20
21.	STD "Make"	61.8	54.2	10.74	198.07
22.	Belimbegovo	58.2	50.5	9.91	196.24
23.	Porodin	56.5	48.1	8.81	183.15
24.	Porodin	62.5	54.5	7.15	131.10
25.	Štip	6.8	55.9	5.35	95.79
26.	Gevgelija	61.2	52.7	7.45	141.29
27.	Ohrid	50.3	43.3	6.07	140.14

	Source	Egg wieght	Egg net wieght	μg I⁻ per egg	μg I⁻ per kg
28.	Porodin	64.6	55.7	3.44	61.73
29.	Telak	57.3	49.7	3.39	68.31
30.	Private	64.0	55.3	8.29	149.99
31.	Private	66.9	58.6	5.80	98.90
32.	PTP "Prestiž"	64.0	55.5	3.67	66.05
33.	Makes – Bitola	64.9	56.0	4.90	87.59
34.	SUD "Sanja"	64.1	55.8	12.97	232.48
35.	Živino Komerc	64.8	55.7	5.81	104.22
36.	Štip	55.1	47.2	5.57	117.92
37.	Private	57.0	49.2	4.94	100.43
38.	Probištip	58.5	50.5	2.83	56.07
39.	Private	62.1	53.7	3.71	69.00
40.	Private	59.9	51.4	8.18	159.16
41.	s. Crnosed	58.4	51.5	3.58	69.50
42.	STD "Bundaleski"	56.2	48.6	7.71	158.56
43.	s. Orizari	67.9	58.9	7.08	120.21
44.	Belimost – Bitola	70.3	61.0	9.98	163.67
45.	s. Dragosani	67.8	59.7	4.59	76.91
46.	s. Stence – Tetovo	78.2	68.7	5.76	83.89
47.	Žito Polog	62.3	54.2	10.25	189.16
48.	Agro Resen	55.7	47.3	7.54	159.33
49.	Gevgelija	60.4	52.3	7.92	151.50
50.	Tetovo	64.2	55.9	4.57	81.72
51.	Kičevo	74.5	65.0	11.40	175.38
52.	Kičevo	68.5	59.5	4.16	69.92
53.	s. Miloševo – Prilep	58.0	51.0	2.30	45.10
54.	s. Sv. Mitrino	58.5	51.0	1.01	19.80
55.	s. Bučim	66.5	57.0	1.41	24.74
56.	s. Podvis	62.5	53.5	2.49	46.54
57.	s. Vrbeni	54.0	46.0	7.12	154.78
58.	s. Berovci	48.0	51.4	7.60	147.86
59.	Kruševo	60.0	52.0	70	13.46
60.	Zadruga Polog	68.0	58.4	10.14	173.63
61.	Belimbegovo	64.3	55.5	5.52	99.46
62.	Idrizovo	69.8	61.7	8.15	132.09
63.	Gevgelija	64.7	56.9	9.31	163.62
64.	Anska Reka	61.5	53.2	5.14	96.62
65.	Gevgelija	72.7	63.1	13.69	216.96
66.	Ergelija	68.7	60.0	7.03	117.17
67.	Štip	54.8	46.5	3.11	66.88
68.	s. Dolneni	65.7	56.5	5.93	104.96
69.	Demir Hisar	60.5	52.0	4.38	84.23
70.	Porodin	59.9	51.7	6.83	132.11
71.	Agroplod	63.7	54.8	5.91	107.85

Results

Iodine contents are given in Table 1. Comparable values are presented by the parameter microg I⁻/dl. The weight pro egg ranges from 59–74 g, the eggs with the lowest weight have shell of 6.7–8.5 g whereas bigger eggs do not have proportionally higher shell weight. The highest iodine level was 23 microg I⁻/dl, the lowest below 1 microg I⁻/dl. Histogram 1 shows 84% of the iodine values in the range from 3–10 microg I⁻/dl. The average iodine content of all 71 samples is x = 5.86 ± 2.91 microg I⁻/dl, median 5.80. (Table 2).

Table 2 – Табела 2

Summary statistics for iodine contents in egg samples

Statistic parameters	μg I⁻ per egg	μg I⁻ per kg
Count	71	71
Average	5.86	109.87
Median	5.81	104.22
Geometric mean	4.82	91.36
Standard deviation	2.92	51.82
Standard error	0.35	6.15
Minimum	0.14	2.81
Maximum	13.69	232.48
Lower quartile	3.58	69.5
Upper quartile	7.54	147.86
Skewness	0.441	0.15
Kurtosis	0.11	-0.38
Coeff. of variation %	49.77	47.17

Discussion

Iodine in the diet of the population can be supplemented by its inclusion in animal feed. Maximal levels of feed additives which are permitted in the UK and in former Yugoslavia is 40 mg per kg complete feed (Great Britain Feeding Stuff Regulations 1991 and 1993).

The source of iodine in standard feed of chickens includes fishmeal, the iodine content of which varies. In this area iodine is supplemented in chicken feed by fishmeal imported from Italy, Ireland and other casual manufacturers. Iodine is also added in the form of potassium iodide with Salt (NaCl), 0.5% per kg animal feed. One animal feed contains 5 g NaCl iodized salt with 50 microg KI. The principal but unstable source of iodine in egg production is fishmeal. Iodine is an essential element in the diet with deficiency manifesting itself most noticeably by effecting the reproductive function, and this is often added to manufactured animal feed (7). In the study of Wenlok et

al. iodine levels in fish varies between fish species from 100 microg I^- to 2,100 microg I^-/kg. (8).

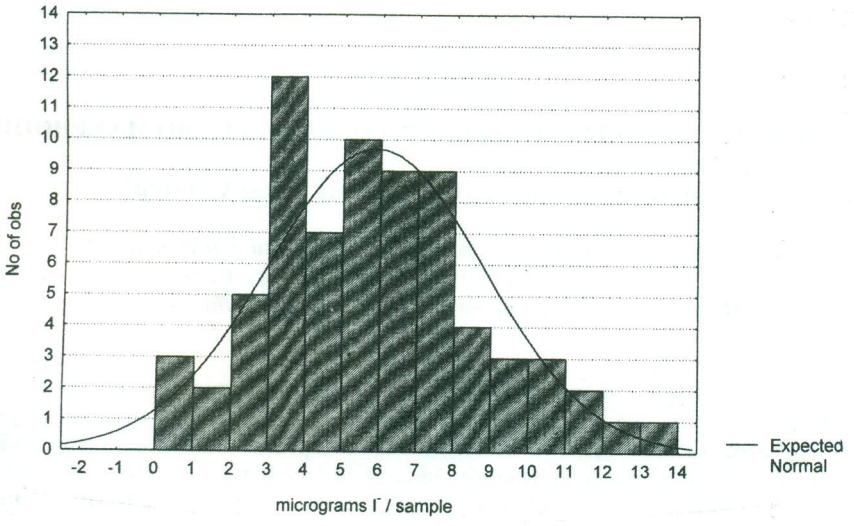
Iodine is not a stable element, it is possible that up to 50% can be lost during processing and storage. This is particulary the case with potassium and sodium iodides, which lose iodine very rapidly when they come into contact with other minerals and moisture (8).

Garber, Henkin and Osterland (9) produced iodine enriched eggs by feeding chickens with feed containing several species of kelp all of which are approved feed additives. This eggs contained an average of 711 microg iodine/egg. In comparison to the eggs in our area (Table 1) the eggs in our study contain an average of 3–10 microg iodine. Iodine enriched eggs produced by special feed are commercialy sold in Japan and have been reported to reduce plasma levels of cholesterol and triglycerides in laboratory animals (10) and increase high-density lipoproteins cholesterol in human subjects (11). Iodine enriched eggs have been reported to reduce plasma cholesterol in human and laboratory animals, urinary iodine excretion in the iodine enriched egg group increased threefold compared with the baseline (9).

The eggs of the manufacturers in Macedonia contain maximum 230 microg I^-/kg whereas the average in Great Britain was in 1985 370 microg I^-/kg and in 1991 340 microg I^-/kg iodine. This demonstrates that the contribution of iodine from eggs to the diet in Macedonia is relatively small. The production rate of eggs in Macedonia was designated to provide the Yugoslavian market with 60% of the total Macedonian output.

Histogram No. 1 – Хистограм бр. 1

Measurement of iodine in egg samples



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Резиме

СОДРЖИНА НА ЈОД ВО ЈАЈЦАТА ВО ИСХРАНАТА ВО МАКЕДОНИЈА

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Македонија е значаен производител на кокошкини јајца во просторот на поранешна Југославија, експортирајќи повеќе од 60%. Продукцијата на јајца се обезбедува од 14 општествени специјализирани организации и од приватници кои пласираат свои производи на пазарот. Јајцата се најефтина протеинска храна, обезбедуваат истовремено и 5% од јодната диета на возрасниот организам. Во региони

со негативен јоден биланс, во секојдневната диета, јодот внесен преку јајцата има свое место. Познато е дека нашите водни ресурси се оскудни со јод. Јодните потреби се 150–200 микрограми дневно што се обезбедуваат преку јодираната сол набавена од повеќето земји во Европа. Во испитаните од нас 71 примероци од сите фарми и позначајни приватни производители наоѓаме јод 40–220 микрограми/кг. Тоа е под вредностите во Велика Британија каде што јодот во јајцата изнесува 340–370 микрограми/кг. Количината на јод во јајцата зависи и од јодната содржина на рибното брашно во крмната смеса импортирана од Италија, Ирска и други производители. При подготвувањето и складирањето на крмната смеса се губи околу 50% од јодот. Додатокот на сол (NaCl) во смесата е 0,5%/кг што внесува само 50 микрограми/кг. Кај нас во едно јајце има помеѓу 3–6 микрограми јод. Некои производители на јајца приготвуваат крми со богата содржина на јодни адитиви и произведуваат јајца збогатени со јод, и тоа 711 микрограми Г/јајце.

Клучни зборови: јод во јајцата, јоден дефицит, надополнување на јод.

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