



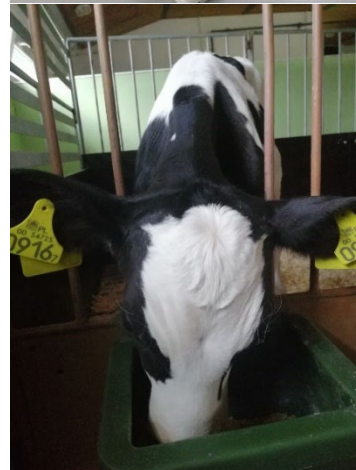
The form of administration and dose of astaxanthin on calves' growth and health

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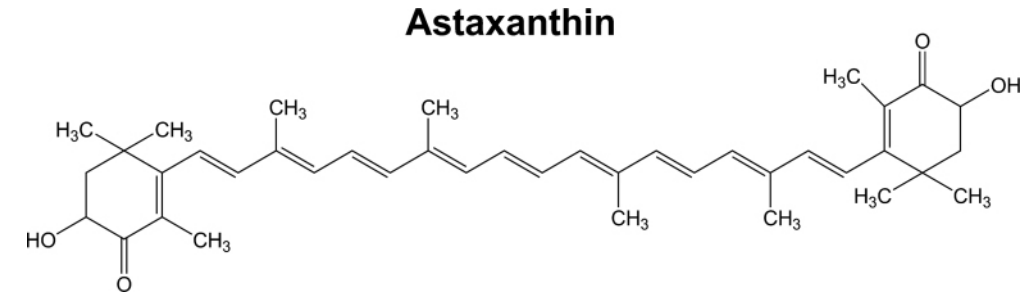


Astaxanthin

- Astaxanthin is a naturally occurring carotenoid pigment, belonging to the same family as beta-carotene, lutein, and lycopene. It is responsible for the red-orange coloration in many marine organisms, including salmon, shrimp, and lobster.

- **Sources of Astaxanthin**

- **Natural Sources:** Astaxanthin is primarily found in microalgae (e.g., *Haematococcus pluvialis*), yeast, salmon, trout, krill, shrimp, and crayfish. The microalga *Haematococcus pluvialis* is the richest known source.
- **Synthetic Production:** It can also be synthetically produced and is commonly used as a feed supplement in aquaculture to enhance the color of farmed salmon and other seafood.



Li, Zhongrui & Dong, Xin & Liu, Hongling & Shi, Huanqi & Fan, Yan & Hou, Dingshan & Zhang, Xiaomei. (2013). Astaxanthin protects ARPE-19 cells from oxidative stress via upregulation of Nrf2-regulated phase II enzymes through activation of PI3K/Akt. Molecular vision. 19. 1656-66.

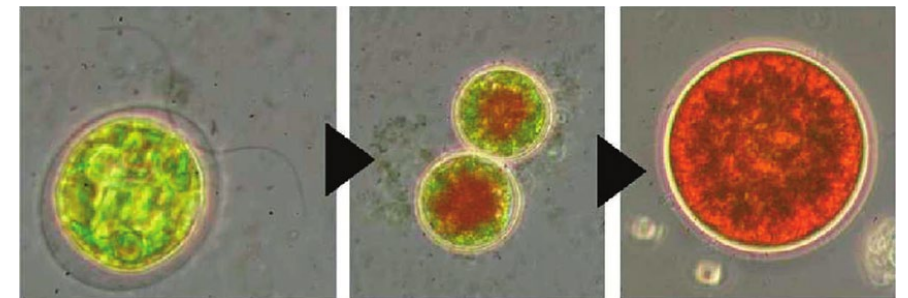


FIG. . Microscopic images of *Haematococcus pluvialis* showing its growth stages. Kirs

Astaxanthin counteracts:

- inflammation (Kupscinkas et al., 2008)
- cancer (Palazzo et al., 2015; Kavitha et al., 2013),
- diabetes (Parisi et al., 2008),
- cardiovascular diseases (Pashcow et al., 2008; Sieradzka and Kołodziejczyk-Czepas, 2016),
- neurodegenerative diseases (Galasso et al., 2018),
- liver diseases (Turkez et al., 2012),
- and also stimulates the immune system (Ambati et al., 2014).

Biological Function

- Astaxanthin acts as a powerful antioxidant, helping protect cells from oxidative stress by neutralizing free radicals. Its antioxidant activity is considered to be significantly stronger than other carotenoids, like beta-carotene and vitamin E.

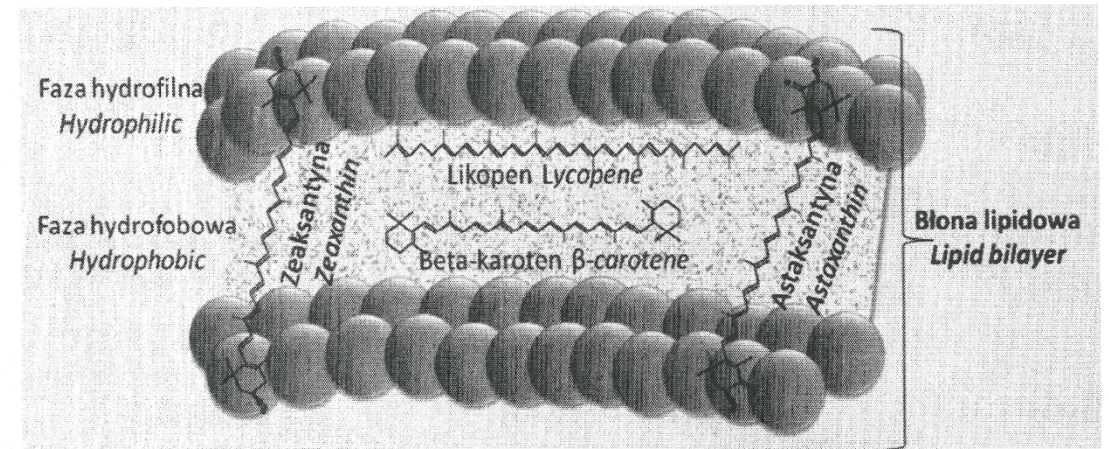


Fig.1. Distribution of carotenoids in lipid membranes (Pogorzelska et al. 2016).

The aim of the study:

determine the form of administration and dose of astaxanthin (AXT)
on the development and health of calves during the period of feeding
with milk replacer

Material and methods

- *Haematococcus pluvialis* (Podkowa AD 1905 sp. z o.o., Lublin, Poland)
- 32 pHF calves, divided into 4 groups, 8 animals in each.

I
8
Control
Milk replacer
Concentrates

II
8
Milk replacer
AXT in
Concentrates
20 mg/kg DM

III
8
AXT 0,11 mg/1
kg BW
In Milk replacer
Concentrates

IV
8
AXT 0,25
mg/1 kg BW
in Milk
replacer
Concentrates

Material and methods

- Calves were kept in individual cages (Alfa Laval) with perforated wooden floors bedded with straw and equipped with automatic drinkers and feeding troughs.
- AXT dissolved in a small amount of milk replacer was administered to the calves (Groups III and IV)
- The experiment was carried out until the 56th day of the calves' life.
- During the experimental period, the body weights and body weight gains of calves were determined.
- Blood was collected on the 1st, 7th, 14th, 28th, and 56th day of the calves' life.
- The obtained data were analyzed using Statistica 13.1 (2021).

Table 1. The components (as fed), chemical composition and nutritive value of concentrates

Item	Concentrate
corn	51
oat	18
soybean meal	27
limestone	1
kalvicin PRO	3
in 1 kg:	
DM, g	897
CP, g	179
EE	42,5
PDIN	147
PDIE	130
UFL	1,1

Kalvicin PRO w 1 kg (g): Ca212.8, P 60.0, Na 88.0, Mg 25, Zn 4.0, Mn 2.5, Fe 1.5, vit. E 0.8, (IU): vit. A 450000., vit. D3 100000

Table 2. The results of calf rearing up to 56 days of age depending on the amount and form of astaxanthin administered

Item	I	II	III	IV	P	SEM
Body weight, kg						
1 d	43,94	41,85	43,00	43,5	0,69	0,69
56 d	80,9	79,5	89,9	87,3	0,15	1,88
Daily gain, kg						
1-56 d	672	685	852	796	0,1	30,7
Colostrum quality	1,05	1,05	1,05	1,05	0,42	0,001
Feed intake:						
Milk replacer, kg	352,0 A	338,8 B	363,0 C	351,0 ABC	0,01	2,66
concentrate, kg	20,61	21,2	27,5	24,6	0,38	1,55
AXT, mg/d	0	8,16	5,25	9,87	-	-
AXT, mg/56 d	0	425	273	514	-	-

Group I – concentrate without AXT, Group II – AXT in concentrate mixture (20 mg/kg DM), Group III – AXT in milk replacer (0.11 mg/kg body weight), Group IV – AXT in milk replacer (0.25 mg/kg body weight). a, b, c – statistically significant differences at $P \leq 0.05$; A, B, C – highly significant statistical differences at $P \leq 0.01$; x, y, z – differences at $0.05 < P \leq 0.09$ (trend).

Table 3. Selected biochemical and immunological blood indicators of calves depending on the amount and form of astaxanthin administered

Item	Age (d)						P	
	1	7	14	28	56			
Indicators of rumen function development						group	age	gr x age
Glucose, mmol/ml						0,01	<0,01	0,17
I	91	134,8	115,5	94,5	114,5			
II	60	131,5	127,5	123,5	101,0			
III	67	130,3	157,8	154,0	123,3			
IV	108	163,0	134,6	144,6	136,0			
NEFA, mmol/ml						0,06	<0,01	<0,01
I	0,66	0,28	0,23	0,22	0,21			
II	0,46	0,29	0,16	0,23	0,17			
III	0,32	0,20	0,16	0,24	0,17			
IV	0,38	0,25	0,19	0,23	0,17			
BHBA, mmol/ml						<0,01	<0,01	<0,01
I	0,05	0,04	0,03	0,06	0,25			
II	0,07	0,05	0,04	0,05	0,29			
III	0,06	0,04	0,04	0,04	0,04			
IV	0,05	0,04	0,05	0,03	0,06			

Item	Age (d)						P	
	1	7	14	28	56			
						group	age	gr x age
HDL, mg/dl						0,03	<0,01	0,02
I	6,55	52,75	31,05	44,78	41,9			
II	9,87	46,82	38,35	45,78	41,35			
III	15,65	53,8	48,55	55,3	45,9			
IV	13,43	60,5	58,08	51,5	54,65			
LDH lactate dehydrogenase; U/L						0,01	<0,01	0,89
I	1299	1482	1255	1319	1702			
II	1592	1440	1453	1703	2173			
III	1056	1004	1058	1220	1482			
IV	1318	1312	1231	1533	1800			
Phosphorus, mg/dL						<0,01	<0,01	<0,01
I	7,47	8,59	8,26	9,18	8,70			
II	7,08	8,98	9,44	9,40	9,75			
III	9,05	9,69	10,61	10,64	10,35			
IV	6,94	11,15	12,49	10,32	9,92			
Magnesium, mg/dL						<0,01	0,24	0,75
I	2,68	2,09	1,95	2,39	2,15			
II	2,11	2,15	2,07	2,20	2,13			
III	3,80	2,34	2,58	2,11	3,88			
IV	4,50	3,13	3,99	2,25	3,17			

Item	Age (d)				P	
	7	28	56			
				group	age	gr x age
IgG, mg/g				0,01	0,54	0,54
I	12,11	11,75	11,46			
II	13,63	12,49	13,39			
III	12,88	13,01	13,31			
IV	13,14	13,19	12,82			
IgM, mg/g				0,01	0,68	0,41
I	2,93	2,99	2,99			
II	2,80	2,98	2,98			
III	2,26	2,24	2,16			
IV	2,38	2,36	2,45			
IgA, mg/g				0,01	0,42	0,32
I	1,01	1,11	0,92			
II	1,02	1,32	1,29			
III	1,23	1,34	1,29			
IV	1,51	1,43	1,40			

Conclusions

- Astaxanthin administered during the rearing period has a positive effect on calf weight gain, as well as on biochemical and immunological blood parameters.
- Astaxanthin dissolved in milk replacer is better absorbed by calves.
- The optimal dose of astaxanthin for calves is half the recommended dose for adult animals.
- Intake of astaxanthin with milk replacer at a dosage of approximately 5 mg per day stimulates the calves' appetite.



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Thank you for your attention



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