Full-fat silkworm-based diets for laying quails: impact on egg fatty acid profile

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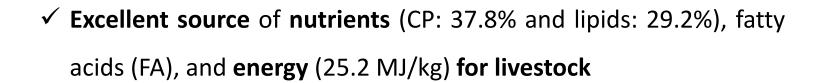


INTRODUCTION



Silkworm (Bombyx mori L.) pupae

✓ Pupae are the major by-product of the silk industry/sericulture



✓ Valuable insect species to replace some conventional feedstuffs for livestock species





Main FA classes (% FAME)					
Total SFA	28.4				
Total MUFA	33.6				
Total PUFA	37.8				
n-6	8.06				
n-3	29.7				
n-6/n-3	0.27				











Japanese quail (Coturnix japonica L.)

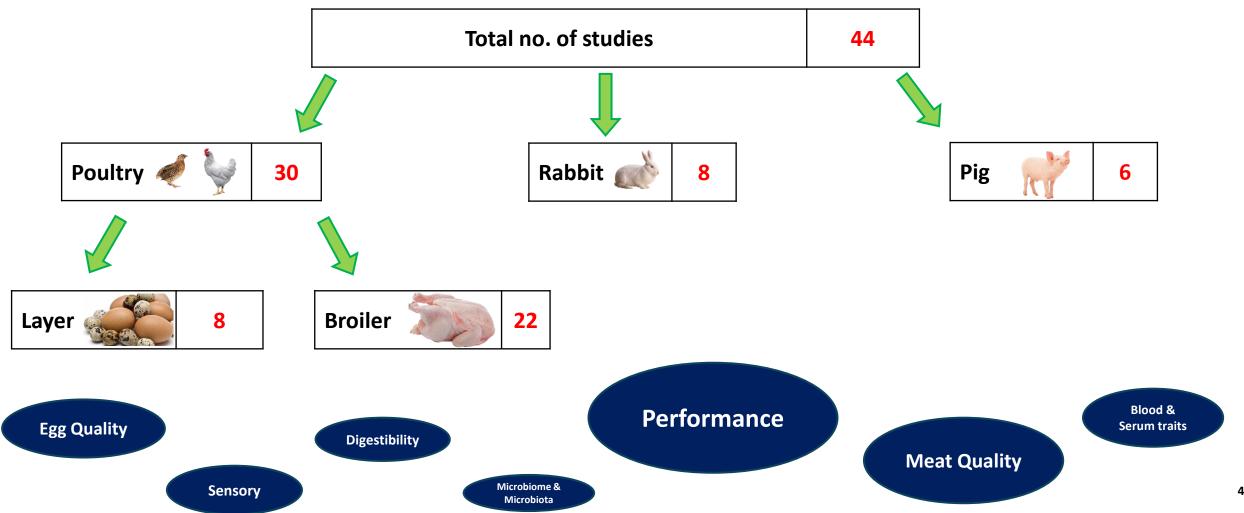
- ✓ Species of growing economic interest for meat & egg production in different areas of the world, due to:
 - > Early sexual maturity
 - > Rapid growth
 - Short generation interval
 - Limited feed & space requirements per bird
 - > Tradition







Research studies on the utilisation of silkworm by-products (pupae and oil) in monogastric livestock production



OBJECTIVE



To test different full-fat silkworm meal (SWM) inclusion levels (0%, 4%, 8%, and 12%)

into laying quails' (Coturnix japonica) diet and evaluate egg proximate and FA profile











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MATERIALS AND METHODS

A total of 240, 31-day-old female Japanese quails were randomly assigned to four dietary groups (12 replicates/treatment; 5 quails/replicate)

The experiment started when the oviposition rate was 81% (63 days of age)

	Experimental diets							
Control (0% SWM)								

Diets were isonitrogen and isoenergy





Experiment layout

- Trial duration: 8-weeks
- Feed and water: ad libitum
- The average temperature and relative humidity were 21 °C and 76%, respectively
- The adopted photoperiod was 18L:6D

Egg collection, sample preparation, proximate and FA profile analyses

During the 8th week of trial, 7 eggs/cage collected & pooled to 1 sample (12 pooled samples/treatment)

Statistical analysis

Data were analysed using 1-way ANOVA with the experimental diets as a fixed effect, unit: pooled samples





Proximate composition (g/100 g whole egg) of eggs collected during the 8th week of trial

	Significance				
	C SWM4 SWM8 SWM12				
Moisture	72.9	72.9	73.0	73.0	ns
Protein	13.1	13.1	13.0	13.2	ns
Lipids	11.5	11.6	11.4	11.2	ns
Ash	0.97	1.00	0.99	0.99	ns

ns: not significance







FA classes (% FAME) of eggs collected during the 8th week of trial

		Ciamifica mas				
	Control	SWM4	SWM8	SWM12	 Significance 	
Lipids, g/100 g	11.5	11.6	11.4	11.2	ns	-
Total SFA	36.3 ^{ABa}	36.6 ^A	35.2 ^{Bb}	35.3 ^{Bab}	*	
Total MUFA	36.8 ^c	37.9 ^c	43.8 ^A	40.2 ^B	*	
Total PUFA	25.7 ^A	23.4 ^B	20.1 ^C	23.6 ^B	*	
<i>n</i> -6	23.3 ^A	19.7 ^B	15.1 ^{Cb}	16.6 ^{Ca}	*	
n-3	2.37 ^D	3.71 ^C	5.05 ^B	7.03 ^A	*	X 4.
n-6/n-3	9.82 ^A	5.32 ^B	2.99 ^c	2.36 ^D	*	



ns: not significance; A,B Different superscript letters differ for P<0.01; a,b Different superscript letters differ for P<0.05.





Differences in main classes attributable to variation in single fatty acids (% FAME)

		Experimental groups				— Significance
SFA		С	SWM4	SWM8	SWM12	Significance
	Palmitic acid (C16:0)	24.4 ^B	24.9 ^A	25.3 ^A	24.9 ^{AB}	*
DALIEA	Stearic acid (C18:0)	10.9 ^{Aa}	10.4 ^{Ab}	8.70 ^B	9.19 ^B	*
MUFA	Palmitoleic acid (C16:1)	3.09 ^B	3.10 ^B	3.43 ^A	4.41 ^B	*
	Oleic acid (C18:1 <i>n</i> -9)	32.1 ^c	32.9 ^c	35.8 ^A	37.6 ^B	*
PUFA	Linoleic acid (C18:2 n-6)	19.9 ^A	16.9 ^B	15.1 ^c	13.4 ^D	*
	α -Linolenic acid (C18:3 n -3)	<mark>0.89</mark> □	1.76 ^C	3.05 ^B	4.86 ^A	X 4 *
	Arachidonic acid (C20:4 n-6)	2.84 ^A	2.28 ^B	1.41 ^c	1.24 ^c	*
	Docosahexaenoic acid (C22:6 n-3)	1.40 ^B	1.80 ^A	1.74 ^A	1.86 ^A	*

^{A,B}Different superscript letters differ for P<0.01; ^{a,b}Different superscript letters differ for P<0.05.



CONCLUSIONS



Dietary inclusion of full-fat silkworm pupae meal on quails eggs:

- proximate composition <u>remained comparable</u> among the groups
- omega-3 FA proportion <u>linearly increased</u> with the SWM inclusion level
- omega-3 FA increased by <u>≈4.7 times</u> in SWM12
- improved <u>n-6/n-3</u>



SWM12 is suitable to feed laying quails for improving the <u>nutritional value</u> of the egg

live performances?.....













Thank you very much for you attention!

ACKNOWLEDGEMENTS

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Chemical composition (g/100 g as is), mineral content (mg/kg, as is), 1-Deoxynojirimycin content (1-DNJ: μg/g), gross energy content (GE: MJ/kg) of SWM and the experimental diets

	SWM		Experimental diets					
	SWIVI	С	SWM4	SWM8	SWM12			
DM	93.5	90.9	91.1	90.8	91.4			
СР	37.8	21.5	21.8	21.0	21.2			
Lipids	29.2	6.71	4.40	3.67	4.81			
Ash	4.89	9.78	10.8	10.6	13.1			
Starch	-	32.2	30.2	31.4	27.2			
Chitin	1.46	0.00	0.02	0.05	0.10			
Ca	-	25.1	25.1	25.0	25.0			
P	-	3.51	3.51	3.50	3.50			
1-DNJ	0.76	-	0.25	0.43	0.91			
GE	25.2	12.2	12.2	12.2	12.2			





FA classes (% FAME) of SWM and experimental diets

	CVA/DA	Experimental diets					
	SWM -	С	SWM4	SWM8	SWM12		
Lipids, g/ 100 g	29.2	6.71	4.40	3.67	4.81		
Total SFA	28.4	17.5	22.1	26.8	28.0		
Total MUFA	33.6	24.0	27.7	31.4	32.0		
Total PUFA	37.8	58.0	49.6	41.1	39.4		
<i>n</i> -6	8.06	52.3	39.6	26.6	21.0		
n-3	29.7	5.70	9.97	14.5	18.4		
n-6/n-3	0.27	9.17	3.97	1.84	1.14		







Single fatty acids (%) of the SWM and experimental diets

	CIAINA		Experimental diets			
	SWM -	С	SWM4	SWM8	SWM12	
Palmitic acid (C16:0)	21.6	12.7	16.6	21.0	22.1	
Stearic acid (C18:0)	5.75	3.49	4.07	4.27	4.63	
Palmitoleic acid (C16:1)	0.91	0.09	0.30	0.52	0.61	
Oleic acid (C18:1)	32.5	23.8	27.2	30.7	31.2	
Linoleic acid (C18:2 n-6)	7.88	52.2	39.5	26.5	20.8	
α-Linolenic acid (C18:3 n-3)	29.6	5.70	9.94	14.4	18.3	





Performances and production

		Cignificance			
	С	SWM4	SWM4 SWM8		Significance
N. of cages	12	12	12	12	
FCR (Week1-8)	2.74 ^B	3.00 ^{AB}	3.13 ^A	3.24 ^A	*
Egg production (Week1-8), %	84.1 ^{Bb}	86.3 ^{AB}	86.8 ^{ABa}	87.0 ^A	*
Egg weight (Week1-8), g	13.6	13.8	13.9	13.5	ns

ns: not significance; A,B Different superscript letters differ for P<0.01; a,b Different superscript letters differ for P<0.05.





Egg health indexes

		Ci-nifi			
	С	SWM4	SWM8	SWM12	 Significance
Atherogenicity index (AI)	0.41 ^{ABb}	0.43 ^{Aa}	0.42 ^{ABab}	0.41 ^B	*
Thrombogenicity index (TI)	1.18 ^{ABa}	1.22 ^A	1.13 ^{Bb}	1.16^{ABab}	*
Peroxidability index (PI)	45.5 ^A	44.7 ^A	39.0 ^B	43.0 ^A	*
Hypocholesterolemic/ Hypercholesterolemic index (hH)	2.31 ^{AB}	2.21 ^C	2.23 ^{BC}	2.34 ^A	*

^{A,B}Different superscript letters differ for P<0.01; a,b Different superscript letters differ for P<0.05.

