

CHEMICAL COMPOSITION OF BODIES AND ORGANS OF PIG FETUSES IN THE LAST FORTY DAYS OF INTRAUTERINE LIFE

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Abstract

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Proteins are the main organic component of pig fetal bodies. Their relative amount increases from 5.03 ± 0.16 % in fetuses 74 days old to 9.13 ± 0.25 % in 114-day old fetuses. The steepest increase of both relative and actual amounts of proteins in fetal body is seen until the 94th day of gestation. On the 114th day of gestation the significant positive relation between fetal mass and protein per cent in their bodies can be demonstrated. The relative fat amount in fetal bodies increases between 74th and 84th day from 0.72 ± 0.03 to 1.11 ± 0.02 % and between 94th and 104th gestation day from 1.13 ± 0.02 to 1.53 ± 0.03 %. In the last 10 days prior to birth the relative fat content in fetal bodies statistically significantly decreases from 1.53 ± 0.03 to 1.37 ± 0.05 %. The relative ash content in fetal bodies rises during the whole followed period and in 114-day old fetuses reaches the value of 3.95 ± 0.03 %. The amount of all the three followed components of fetal bodies – protein, fat and ash – was found to be quantitatively sevenfold higher at the 114th day of gestation when compared with the 74th day of their age. The body mass of fetuses increases four times during the last 40 days of intrauterine life. Further the development of mass and chemical composition of the heart, lungs and liver, and changes in the mass of the kidney were followed. The most pronounced changes occurred in the chemical composition of the liver the relative protein content of which decreased from 12.11 ± 0.20 to 7.55 ± 0.20 % in the last twenty days prior to birth.

Pig fetuses, body mass, organ mass, protein, fat, ash and dry matter content.

Although data concerning the chemical composition of fetal bodies are encountered in literature (Svěčín et al. 1967, Pomeroy 1960, Curtis et al. 1969) the detailed information concerning especially the last 40 days of intrauterine life is very scarce. Svěčín et al. (1967) reports e. g. on chemical composition of fetal bodies at 88th and 113th gestation day, Pomeroy (1960) reports on fetuses 51, 74, 95 and 114 days old stating that heavier fetuses of the same age group have higher relative content of protein. Curtis et al. (1969) when prolonging the gestation period of sows found that the biochemical composition of 114-day old fetuses was not changed by the prolonged gestation by 1 week.

In our previous work (Padalíková et al. 1972; Ježková et al. 1971) we followed the changes of weight and hydration of pig fetuses that occur during the last 40 days of intrauterine life. We have decided to expand this knowledge by an analysis of changes in chemical composition of pig fetal bodies and organs.

Materials and Methods

The experiments were carried out on 108 fetuses of 12 Large White sows. The age of fetuses was 74, 84, 94, 104 and 114 days, resp. The fetuses were removed from their mothers by Cesarean section. They were exsanguinated, the abdominal cavity opened, intestines and stomach removed and their contents taken out. The organs were then weighed, measured and put back into the body cavity (Ježková and Padalíková 1970, 1972, 1974). We removed also heart, lung, liver, right and left kidney of fetuses. These organs were also weighed, samples for chemical analysis taken, and returned back into the body. The fetuses were then re-weighed. Bodies of fetuses were finally ground and samples for chemical analysis collected. Dry matter content and the proportion of fat, protein and ash were determined by drying at 90 °C. Total nitrogen was determined from three samples of dry matter using the Conway micromethod (Conway 1957). The fat content was determined by the method described by Montemurro and Stevenson (1960). The ash content was obtained by mineralizing the dry matter samples in an electric oven at 500 °C.

The details concerning the rearing of sows, their nutrition during gestation and of the Cesarean section were described previously (Padalíková et al. 1972).

Results

Protein is the main organic component of bodies of pig fetuses in all followed age categories. Their relative content increases from 5.03 ± 0.16 % in 74 days old fetuses to 9.13 ± 0.25 % in fetuses 114-day old. Statistically highly significant differences were found between days 74 and 84 ($P < 0.01$), 84 and 94 ($P < 0.001$), and 104 and 114 ($P < 0.01$) (Table 1).

By positive correlation coefficient ($r = \pm 0.7057$, $s_r = 0.0861$) we have proved the relation between the fetal mass and the protein content in bodies of 114 days old fetuses. In other age groups, however, this relation was not found.

The relative content of fat in bodies of pig fetuses shows a statistically significant increase between day 74 and 84 ($P < 0.001$) and between day 94 and 104 ($P < 0.001$). In the last 10 days, statistically significant decrease of relative fat content in fetal bodies, however, appears ($P < 0.05$) (Table 1).

The relative ash content in fetal bodies of pigs shows an increasing tendency during the whole period under observation with the marked rise between day 94 and 104 from the value of 3.07 ± 0.03 to 3.88 ± 0.06 % ($P < 0.001$). The difference in relative ash content between fetuses 74 and 84-day old and 84 and 94-day old are also statistically significant ($P < 0.01$) (Table 1).

The actual protein content in bodies of pig fetuses has the same increasing tendency during the whole followed period. The increase is very marked between days 74 and 84 ($P < 0.001$) and 84 and 94 ($P < 0.001$) when the actual protein

Table 1
Relative content of protein, fat, ash and dry matter in bodies of pig fetuses in the last forty days of intrauterine life

Age of fetuses d	n	Body mass g	Protein %	Fat %	Ash %	Dry matter %
74	29	262 ± 30	5.03 ± 0.16	0.72 ± 0.03	2.41 ± 0.11	11.30 ± 0.15
84	23	511 ± 95	5.75 ± 0.17	1.11 ± 0.02	2.86 ± 0.06	13.32 ± 0.19
94	25	785 ± 135	7.96 ± 0.12	1.13 ± 0.02	3.07 ± 0.03	15.55 ± 0.08
104	33	904 ± 197	8.06 ± 0.11	1.53 ± 0.03	3.88 ± 0.06	19.23 ± 0.19
114	31	1020 ± 282	9.13 ± 0.25	1.37 ± 0.05	3.95 ± 0.13	19.49 ± 0.31 ¹⁾

¹⁾ n = 20
± ... S. E. M.

Table 2

Protein, fat and ash mass in the bodies of pig fetuses in the last forty days of intrauterine life

Age of fetuses d	n	Protein g	Fat g	Ash g
74	29	12.9 ± 0.5	1.8 ± 0.1	6.3 ± 0.3
84	23	28.6 ± 1.3	5.6 ± 0.3	14.2 ± 0.6
94	25	59.3 ± 1.9	8.6 ± 0.3	23.0 ± 0.3
104	33	73.5 ± 3.5	14.1 ± 0.8	35.7 ± 2.0
114	31	97.4 ± 6.6	14.4 ± 0.8	41.7 ± 2.8

± ... S. E. M.

content in foetal pig body increases roughly twofold. The differences in the actual protein content in bodies of 94 and 104-day old fetuses ($P < 0.001$) and as well of 104 and 114-day old fetuses ($P < 0.05$) are also statistically important. The 114-day fetus body has about 97.4 ± 6.6 g of protein (Table 2).

The actual fat content shows an increasing tendency till the 104th day. Its rise in the period between day 74 and 84 is almost threefold. The relative differences in the actual fat content in fetal bodies between individual age groups were found to be statistically significant ($P < 0.001$) (Table 2) until the day 104 of the fetal age. 104 and 114-day old fetuses did not, however, differ as far as the actual fat amount is concerned.

The actual ash content was found to increase steadily and statistically significantly in the period examined, its value in the fetal body reaching 42 g at the 114th day. The differences between individual age groups were statistically significant ($P < 0.001$) (Table 2).

The amount of all the three followed components of fetal bodies, i. e. protein, fat and ash, observed on the 114th day of gestation, was approximately sevenfold higher than that on day 74.

The heart mass rises from 1.57 ± 0.45 g of 74-day old fetuses to 7.45 ± 0.41 g in 114-day old ones. The differences in heart mass between individual age groups were found to be statistically highly significant ($P < 0.0001$) (Table 3). Whereas the fetus body mass during the last 40 days of intrauterine life increased four times, the increase in heart mass in the same period was 4.7 fold.

The fall of relative heart hydration was statistically significant between days 74 and 84 and days 94 and 104 ($P < 0.001$), whereas between days 84 and 94, and 104 and 114 it was found to change only statistically insignificantly (Table 6).

In the last twenty days of intrauterine life of fetuses the heart hydration was found to be by 4.5 % higher than the body hydration.

The relative protein content in heart increases till the 114th gestation day, this increase being statistically significant between days 84 and 94 (from 7.97 ± 0.42 to 9.44 ± 0.36 %) ($P < 0.05$) and between days 104 and 114 (from 9.28 ± 0.49 to 10.40 ± 0.43 %) ($P < 0.05$). During the whole experimental period the protein content was found to be relatively higher in heart than in body and lung, in 104 and 114 days old fetuses being even higher than in liver (Table 3 and Table 9).

The fat proportion in heart increases statistically significantly only between days 94 and 104 ($P < 0.01$). In other periods only statistically unimportant variation could be observed (Table 3).

The relative ash content in heart fluctuates statistically insignificantly during the period followed and ranges about 0.8 % (Table 3).

Table 3

Heart mass and percentage of dry matter, protein, fat and ash in the hearts of pig fetuses in the last forty days of intrauterine life

Age of fetuses d	n	Heart mass g	Relative heart mass %	Dry matter %	Protein %	Fat %	Ash %
74	29	1.57 ± 0.45	0.60 ± 0.02	11.06 ± 0.59	7.10 ± 0.51 ¹⁾	1.46 ± 0.18 ²⁾	0.79 ± 0.09 ³⁾
84	23	2.69 ± 0.10	0.53 ± 0.10	13.69 ± 0.14	7.97 ± 0.42 ²⁾	1.39 ± 0.09 ³⁾	0.76 ± 0.08 ³⁾
94	25	4.73 ± 0.20	0.62 ± 0.03	14.19 ± 0.25	9.44 ± 0.36	1.29 ± 0.05	0.82 ± 0.03
104	33	5.90 ± 0.23	0.65 ± 0.01	15.59 ± 0.19 ⁴⁾	9.28 ± 0.49 ⁴⁾	1.61 ± 0.07 ⁵⁾	0.93 ± 0.10 ⁴⁾
114	31	7.45 ± 0.41	0.74 ± 0.03	15.31 ± 0.47	10.40 ± 0.43 ⁶⁾	1.53 ± 0.08	0.80 ± 0.03

¹⁾ n = 13 ⁴⁾ n = 32

²⁾ n = 11 ⁵⁾ n = 31

³⁾ n = 10 ⁶⁾ n = 20

± ... S. E. M.

Table 4

Actual protein, fat and ash mass in pig fetal heart in the last forty days of intrauterine life

Age of fetuses d	n	Protein g	Fat g	Ash g
74	29	0.12 ± 0.01	0.02 ± 0.00 ¹⁾	0.01 ± 0.00
84	23	0.22 ± 0.02	0.04 ± 0.00	0.02 ± 0.00
94	25	0.44 ± 0.02	0.06 ± 0.00	0.04 ± 0.01
104	33	0.44 ± 0.05	0.09 ± 0.01 ²⁾	0.06 ± 0.01 ³⁾
114	31	0.77 ± 0.06	0.11 ± 0.01	0.06 ± 0.00

¹⁾ n = 11

²⁾ n = 31

³⁾ n = 33

± ... S. E. M.

Table 5

Lung mass and percentage of dry matter, protein, fat and ash in pig fetal lungs in the last forty days of intrauterine life

Age of fetuses d	n	Lung mass g	Relative lung mass %	Dry matter %	Protein %	Fat %	Ash %
74	29	7.17 ± 1.02	2.74 ± 0.30	11.18 ± 0.12	5.73 ± 0.24 ¹⁾	0.88 ± 0.05 ¹⁾	0.82 ± 0.03 ¹⁾
84	23	14.42 ± 2.39	2.83 ± 0.26	12.89 ± 0.07	6.44 ± 0.16	1.13 ± 0.11	0.87 ± 0.02
94	25	22.59 ± 4.27	2.96 ± 0.61	11.59 ± 0.13	6.60 ± 0.12	0.90 ± 0.03	0.84 ± 0.01
104	33	28.33 ± 6.33	3.33 ± 0.33	9.99 ± 0.24	5.55 ± 0.20	1.28 ± 0.04	0.66 ± 0.02
114	31	30.20 ± 8.26	3.09 ± 0.79	9.81 ± 0.29	6.40 ± 0.23	1.84 ± 0.13	0.97 ± 0.06

¹⁾ n = 18

± ... S. E. M.

The actual protein content in fetal heart increases markedly as well. So between days 74 and 84, and then between days 84 and 94 of gestation, its absolute amount doubles. Later, the curve is levelling off slightly, the protein content is, nevertheless, increasing, the overall rise being more than six times when comparing the beginning of the period under study and the 114th day.

A similar tendency could be observed in the case of actual changes in fat and ash content in heart (Table 4).

The lung mass of pig fetuses increases from 7.17 ± 1.02 g in 74-day old fetuses to 30.20 ± 8.26 g in 114-day fetuses. The differences in values of lung mass between individual age groups were statistically highly significant ($P <$

< 0.001). In the last ten days of intrauterine life of pig fetuses the weight changes are only statistically unimportant. Thus, the changes in lung mass observed approximately a similar tendency as those in body mass of fetuses. This appears also in the relative mass changes of lung that increased slightly till the 104th gestation day, slightly declining, however, in the last followed decade (Table 5).

The hydration changes of fetal pig lung show, however, entirely different dynamics when compared with body and heart. Whereas between day 74 and 84 an expressed decline in water amount in lung appears ($P < 0.001$), in further period a statistically significant increase of water content in lung, lasting till the 104th gestation day, could be observed. The differences between days 84 and 94 ($P < 0.001$) and days 94 and 104 were found to be statistically significant ($P < 0.001$) (Table 6). On the 104th and 114th day the relative hydration of foetal lung reaches roughly 90 %. Thus, in this period the hydration of lung is higher than in body, heart and liver.

Proteins are quantitatively the most significant organic component of fetal lung. Their relative content increases between day 74 and 84 ($P < 0.02$) and between day 104 and 114 ($P < 0.01$). Between day 94 and 104 a statistically significant decrease, however, appears ($P < 0.01$) (Table 5).

The fat content in lung of pig fetuses increases statistically expressively between day 94 and 104 ($P < 0.001$) and between day 104 and 114 ($P < 0.001$). In other age periods the relative fat content in lung fluctuates statistically insignificantly about 1.0 % (Table 5).

The ash content in lung decreases significantly in 94 and 104-day old fetuses ($P < 0.001$), increasing however between day 104 and 114 ($P < 0.001$). In 74, 84 and 94-day old fetuses, it fluctuates statistically insignificantly around 0.85 % (Table 5).

Table 6
Relative water content in the heart, lungs and liver in pig fetuses in the last forty days of intrauterine life

Age of fetuses d	n	Heart hydration %	Lung hydration %	Liver hydration %
74	29	89.25 ± 0.59	88.58 ± 0.14	80.34 ± 0.24
84	23	86.09 ± 0.24	87.11 ± 0.07	79.68 ± 0.87
94	25	85.85 ± 0.25	88.41 ± 0.13	80.08 ± 0.11
104	33	84.41 ± 0.19	90.61 ± 0.24	79.57 ± 0.68
114	31	84.69 ± 0.47	90.19 ± 0.29	76.36 ± 0.89

± ... S. E. M.

The increase of actual protein content in lung is statistically marked from day 74 to 94, later the value differences were found to be statistically insignificant (Table 7).

The actual fat content in lung increases, however, statistically significantly till the 114th day, when it reaches the value ten times higher than that found in 74-day old fetuses ($P < 0.001$).

The actual ash content in lung increases till the 114th day. The differences in values between 74 and 84-day fetuses and 84 and 94-day fetuses were found to be statistically highly significant ($P < 0.001$). Statistically significant differences in lung ash mass were observed also in fetuses 104 and 114-day old ($P < 0.001$) (Table 7).

Table 7

Actual mass of protein, fat and ash in lungs of pig fetuses in the last forty days of intrauterine life

Age of fetuses d	n	Protein g	Fat g	Ash g
74	29	0.40 ± 0.01	0.06 ± 0.01	0.06 ± 0.00
84	23	0.92 ± 0.04	0.16 ± 0.01	0.12 ± 0.00
94	25	1.48 ± 0.06	0.20 ± 0.01	0.19 ± 0.01
104	33	1.55 ± 0.07	0.35 ± 0.02	0.19 ± 0.01
114	31	1.87 ± 0.09	0.66 ± 0.12	0.29 ± 0.02

± ... S. E. M.

The rise in kidney and spleen mass is statistically significant ($P < 0.001$) only till the 94 th gestation day. Although in further 20 days of intrauterine life their mass increases, the relative differences between the followed age groups are not statistically significant (Table 8).

The relative kidney mass declines statistically between day 74 and 84 ($P < 0.001$), further changes being not significant (Table 8).

The relative spleen mass decreases statistically between day 94 and 104 ($P < 0.01$), namely from 0.15 to 0.11 % of the body mass (Table 8).

Table 8

Actual and relative mass of the kidneys and spleen of pig fetuses in the last forty days of intrauterine life

Age of fetuses d	n	Actual mass of right kidney g	Relative mass of right kidney %	Actual mass of left kidney g	Relative mass of left kidney %	Actual mass of spleen g	Relative mass of spleen %
74	29	1.32 ± 0.05	0.50 ± 0.01	1.35 ± 0.05	0.52 ± 0.01	0.24 ± 0.01 ¹⁾	0.09 ± 0.00 ³⁾
84	23	1.96 ± 0.08	0.39 ± 0.01	1.95 ± 0.10	0.38 ± 0.01	0.66 ± 0.04 ²⁾	0.17 ± 0.04 ³⁾
94	25	3.28 ± 0.14	0.43 ± 0.02	3.32 ± 0.16 ⁴⁾	0.44 ± 0.03 ³⁾	1.13 ± 0.05	0.15 ± 0.01
104	33	3.32 ± 0.18	0.39 ± 0.01	3.48 ± 0.19	0.41 ± 0.02	1.01 ± 0.09	0.11 ± 0.01
114	31	3.84 ± 0.24	0.38 ± 0.02	3.96 ± 0.25	0.40 ± 0.01	1.03 ± 0.09 ⁴⁾	0.11 ± 0.01 ⁴⁾

¹⁾ n = 28

²⁾ n = 21

³⁾ n = 24

⁴⁾ n = 29

± ... S. E. M.

The rise in liver mass in followed fetuses is observed to be statistically significant till the 114th gestation day. The relative differences of liver mass values between individual age groups of fetuses were statistically significant (Table 9). The relative liver mass was found to decrease statistically significantly between day 74 and 84 ($P < 0.001$) and to increase between day 104 and 114 ($P < 0.001$).

The changes in liver hydration show quite a different tendency than in the case of body, heart and lung. Till the 104th gestation day the liver hydration fluctuates statistically insignificantly about 80 %, and only later, between day 104 and 114 the statistically marked drop in water content in liver appears ($P < 0.01$) (Table 6).

Striking changes could be observed in relative protein content in liver, especially in the last twenty days prior to birth. In this period a statistically significant decrease in protein amount from 12.11 ± 0.20 % in 94-day old fetuses to $8.63 \pm$

Table 9

Actual and relative liver mass and relative amount of protein, fat, ash and dry matter in the liver of pig fetuses in the last forty days of intrauterine life

Age of fetuses d	n	Actual liver mass g	Relative liver mass %	Protein %	Fat %	Ash %	Dry matter %
74	29	8.27 ± 1.42	3.14 ± 0.07	11.60 ± 0.36	2.32 ± 0.07	1.33 ± 0.03	19.67 ± 0.24
84	23	11.34 ± 2.40	2.22 ± 0.04	11.41 ± 0.62	2.21 ± 0.15	1.34 ± 0.07	20.32 ± 0.87
94	25	17.40 ± 3.47	2.28 ± 0.10	12.11 ± 0.20	1.67 ± 0.08	1.26 ± 0.02	19.92 ± 0.11
104	33	21.30 ± 4.85	2.49 ± 0.03	8.63 ± 0.33	2.12 ± 0.08	0.98 ± 0.01	20.43 ± 0.68
114	31	32.39 ± 13.44	3.03 ± 0.14	7.55 ± 0.21 ¹⁾	2.14 ± 0.16 ²⁾	0.83 ± 0.07	23.48 ± 0.89

¹⁾ n = 34

²⁾ n = 27

± ... S. E. M.

Table 10

Actual mass of protein, fat and ash in the liver of pig fetuses in the last forty days of intrauterine life

Age of fetuses d	n	Protein g	Fat g	Ash g
74	29	0.83 ± 0.04	0.17 ± 0.01	0.10 ± 0.00
84	23	1.13 ± 0.07	0.21 ± 0.01	0.13 ± 0.01
94	25	1.99 ± 0.10	0.27 ± 0.02	0.21 ± 0.01
104	33	1.77 ± 0.11	0.44 ± 0.04	0.20 ± 0.01
114	34	2.59 ± 0.17	0.61 ± 0.03 ³⁾	0.25 ± 0.03 ³⁾

¹⁾ n = 45

²⁾ n = 31

± ... S. E. M.

± 0.33 % in 104-day fetuses ($P < 0.001$) and to 7.55 ± 0.21 % in 114-day old fetuses ($P < 0.01$) (Table 9) could be found.

The relative fat content in liver decreases statistically between day 84 and 94 ($P < 0.01$), increasing, however, between day 94 and 104 ($P < 0.001$) (Table 9). In further period the relative fat content in liver does almost not change and fluctuates around 2.1 %.

The ash content in liver was found to be statistically significant between day 94 and 104 and 114 ($P < 0.001$), in other periods fluctuating insignificantly around 1.3 % (Table 9).

The actual protein content in liver shows statistically significant increase between day 74 and 84 ($P < 0.001$) and between day 84 and 94 ($P < 0.001$). Between day 94 and 104 a statistically insignificant decline appears, and, on the contrary, in the last ten days a steep rise of this value could be observed ($P < 0.001$) (Table 10).

The actual fat content in liver shows a rising tendency till the 114th gestation day. The differences between individual age groups were found to be statistically highly significant ($P < 0.001$) (Table 10).

The rise of the actual ash content in liver was statistically significant ($P < 0.001$) only until the 94th gestation day. Later the value differences were not statistically important.

Table 11
Changes in the energy content in bodies of pig fetuses from day 74 to day 114

Age of fetuses d	n	Body mass			Protein						Fat					
		74	84		74			84			74			84		
				%	g	kJ	%	g	kJ	%	g	kJ	%	g	kJ	
74 to 84	52	262 ± 30	511 ± 95	5.0	13.0	217.7	5.8	28.6	478.9	0.7	1.9	7	1.6	1.1	5.6	211.0
		Change in energy content			261.2						139.4					
		Total			400.6 kJ											
74 to 94	54	74	94		74			94			74			94		
		262 ± 30	785 ± 134	5.0	13.0	217.7	7.9	59.3	992.9	0.7	1.9	71.6	1.1	8.6	324.0	
		Change in energy content			775.2						252.4					
		Total			1 027.66 kJ											
74 to 104	40	74	104		74			104			74			104		
		262 ± 30	904 ± 197	5.0	13.0	217.7	8.1	73.2	1 225.7	0.7	1.9	71.6	1.5	14.1	537.1	
		Change in energy content			1 008.0						465.5					
		Total			1 473.5 kJ											
74 to 114	63	74	114		74			114			74			114		
		262 ± 30	1 020 ± 282	5.0	13.0	217.7	9.1	97.4	1 630.9	0.7	1.9	71.6	1.4	14.4	542.5	
		Change in energy content			1 413.2						470.9					
		Total			1 884.1 kJ											

Discussion

The analysis of the results of our experiments shows that the highest increase of both relative and actual protein content in bodies of pig fetuses appears until the 94th day of gestation, i. e. in the period when their most intensive growth (Padalíková et al. 1972) and the highest liver ornithine carbamyl transferase activity (Ježková et al. 1972a) were observed.

All the three followed components of the fetal bodies, i. e. protein, fat and ash, reach on the 114th gestation day quantitatively roughly the sevenfold value of that found on day 74.

When subtracting the sum of relative protein, fat and ash contents from the dry matter part a relative carbohydrate content in fetal body is obtained which equals to 3.1 % on day 74, 3.5 % on day 84, 3.4 % on day 94, 5.7 % on day 104, and 5.0 % on day 114.

The relative carbohydrate content in fetal bodies 104 and 114-day old reaches thus the maximum value of the whole period of ontogenetic development of fetuses and piglets. It amounts to 2.9 % in the first postnatal day, 4.1 % on day 6, 2.3 % on day 11, 2.0 % on day 16, 0.6 % on day 21, and 2.7 % on day 26 (Ježková 1964).

In this connection it is interesting to compare also the changes in energy content in protein and fat of pig fetus bodies. The ratio of total energy changes in protein and fat of fetal bodies is as follows: day 74—84 1.9 : 1.0, day 74—94 3.1 : 1.0, day 74—104 2.2 : 1.0, day 74—114 3.0 : 1.0 (Table 11).

The protein deposition in fetal body per day was 1.56 g between day 74 and 84, 2.31 g between day 74 and 94, 2.0 g between day 74 and 104 and 2.01 g of protein per day between day 74 and 114.

When comparing the chemical composition of bodies of 114-day old pig fetuses with that in the first postnatal day (Ježková 1964) a great similarity of the compared values can be observed.

The increase of the heart mass in the last 10 days of intrauterine life in our population of pig fetuses is higher than that of body weight, which is also demonstrated by the increase of the Clark heart coefficient from 0.65 in 104-day old fetuses to 0.74 in fetuses 114-day old ($P < 0.01$) (Clark 1927).

This unusually steep heart growth continues also in the postnatal period when this coefficient increases to 0.82 in piglets 26 and 27-day old (Holub 1967).

The relative lung mass in prenatal period represents about 3 % whereas in the postnatal period during the first month of piglet life it fluctuates around 1.0—1.5% of the body weight. It follows that the growth of lung is more rapid in the prenatal than in the postnatal period (Ježková 1964). The hydration of pig fetuses prior to birth exceeds greatly that of one-day old piglets (Ježková 1969). These findings are in accordance with those of Bland, McMillan and Bressack (1977) concerning the sharp decrease of water content in lungs of newborns. The mineralization of pig fetal lung was found to be markedly lower than that observed in one day old suckling piglets (3.7 ± 0.03 %) and to correspond roughly to lung mineralization of piglets reared on semisynthetic high-fat diet where it varies about 1.1 % (Ježková 1969).

Pronounced changes are observed in the protein content in liver, especially in the last twenty days prior to birth.

Also Brooks and Davis (1969) demonstrated a decrease of the relative

protein content in liver dry matter of pig fetuses in the period between 106th and 110th gestation day, namely from 64.7 to 51.3 %.

From the literature data it can be concluded that such changes in protein content in liver were, in the case of monkey fetuses, induced experimentally by intrauterine malnutrition. This interference causes the decline in liver mass and in protein and fat content in liver, the decrease in fat content of the body, whereas the protein amount in body of monkey fetuses does not change. This decrease in weight was observed to be most marked in liver, spleen and kidney (Myers and Hill 1971). In rats, the intrauterine malnutrition causes the fall in mass of body, liver and spleen, the decrease of protein level and the increase of water content in body of rat fetuses (Wigglesworth 1964; Hohenauer 1969).

Our findings, demonstrating the growth retardation, the decrease in relative liver protein content in the last twenty days prior to birth, the decrease of relative spleen mass, the decrease of fat content in body during the last ten days prior to birth, support our hypothesis suggesting that in the last twenty days prior to birth an unfavourable situation develops for further growth of pig fetuses.

Chemická skladba těl a orgánů fetů prasat v posledních čtyřiceti dnech intrauterinního života

Hlavní organickou součástí těl fetů prasat jsou bílkoviny. Jejich relativní množství stoupá z $5,03 \pm 0,16$ % u fetů 74 denních na $9,13 \pm 0,25$ % u fetů 114denních. Nejprudší vzestup relativního i absolutního množství bílkovin v těle fetů trvá do 94. dne gestace. Ve věku 114. dne gestace prokazujeme významný pozitivní vztah mezi hmotností fetů a procentem bílkovin v jejich těle. Relativní množství tuku v těle fetů stoupá mezi 74. a 84. dnem z $0,72 \pm 0,03$ na $1,11 \pm 0,02$ % a mezi 94. a 104. gestačním dnem z $1,13 \pm 0,02$ na $1,53 \pm 0,03$ %. V posledním desetidenní před narozením relativní obsah tuku v těle fetů statisticky významně klesá z $1,53 \pm 0,03$ na $1,37 \pm 0,05$ %. Relativní obsah popelovin v těle plodů stoupá po celé sledované období a dosahuje u fetů 114denních $3,95 \pm 0,03$ %. Všechny tři sledované složky těla fetů, bílkoviny, tuk i popeloviny dosahují kvantitativně 114. dne gestace sedminásobku množství, které prokazujeme v 74. dnu jejich věku. Hmotnost těla fetů se zvyšuje za posledních 40 dnů intrauterinního života 4krát. Dále byl sledován vývoj hmotnosti a chemické skladby srdce, plic, jater a změny v hmotnosti ledvin a sleziny. K nejzávažnějším změnám v chemické kompozici orgánů dochází v játrech, kde klesá relativní obsah bílkovin v posledních dvaceti dnech před narozením z $12,11 \pm 0,20$ % na $7,55 \pm 0,21$ %.

Химическая структура тел и органов зародышей поросят за последние сорок суток внутриутробной жизни

Основной составной частью тел плодов поросят являются белки. Их относительное количество увеличивается из $5,03 \pm 0,16$ % у зародышей в возрасте 74 суток до $9,13 \pm 0,25$ % у зародышей в возрасте 114 суток. Самое стремительное увеличение относительного и абсолютного количества белков в теле зародышей продолжается до 94 суток беременности. В возрасте 114 суток беременности установлено важное положительное отношение между

массой зародышей и процентом белков в их теле. Относительное количество жиров в теле зародышей увеличивается между 71 и 84 сутками из $0,72 \pm 0,3$ до $1,11 \pm 0,02$ % и между 94 и 104 днем беременности из $1,13 \pm 0,02$ до $1,53 \pm 0,03$ %. Последние десять дней до опороса относительное содержание жиров в теле зародышей статистически значимо понижается из $1,53 \pm 0,03$ до $1,37 \pm 0,05$ %. Относительное содержание зольных веществ в теле зародышей увеличивается в течение всего исследуемого периода и у зародышей в возрасте 114 суток оно достигает $3,95 \pm 0,03$ %. Все три исследуемые компоненты тела зародышей — белки, жиры и зольные вещества — на 114 сутки беременности количественно увеличиваются в семь раз по сравнению с установленным количеством в возрасте 74 суток. За последние сорок дней внутриутробной жизни масса тела зародышей увеличивается в четыре раза. Проводились также наблюдения за развитием массы и химической структурой сердца, легких, печени и за изменениями массы почек и селезенки. Важнейшие изменения химического состава органов происходят в печени, где понижается относительное содержание белков за последние двадцать дней до опороса из $12,11 \pm 0,20$ % до $7,55 \pm 0,21$ %.

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