

## THE EFFECT OF AN EXCLUSIVE MEAT DIET ON THE CHEMICAL CONSTITUENTS OF THE BLOOD.\*

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This paper presents the chemical findings in the blood of two normal men, whose diet for 1 year consisted exclusively of lean and fat meat. While this study was in progress Heinbecker (1) published the results of similar experiments. He studied certain phases of the metabolism of the Baffin Island Eskimos and reported some chemical analyses of the blood. The constituents determined were within normal limits. Because of the lack of facilities where the experiments were conducted Heinbecker found it necessary to bring the filtrates of the blood to his laboratory in St. Louis where the work was completed. The blood filtrates contained moulds, and though the values for the non-protein nitrogen were normal the results may be questioned, because of certain changes occurring in the filtrates of blood on standing.

In both experiments the subjects subsisted on meat alone, but the composition of the diet was not the same in each instance. Heinbecker's Eskimos ate about twice as much protein and about half as much fat as the men studied by us. Our subjects consumed about 120 to 130 gm. of protein and enough fat to make a total intake of 2600 to 3000 calories per day. A full description of the experiment of which this is a part will be published by McClellan and Du Bois (2).

At the outset it was difficult to decide which chemical constituents of the blood were to be studied. The possibility of renal damage suggested, of course, the study of some of the non-protein

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nitrogenous substances. The traditional association of meat with uric acid metabolism made the study of the uric acid desirable. As the plasma showed a milkiness soon after the beginning of the experiments, the blood cholesterol was observed. Only a few analyses of the calcium and phosphorus were made. The

TABLE I.  
*Blood Figures of Subject K. A. Expressed in Mg. per 100 Cc.*

Date.	Non-protein N.	Urea.	Uric acid.	Creatinine.	Sugar.	Serum Ca.	Plasma P.	NaCl	R. B. C.	Plasma.	Remarks.
<i>1928</i>											
Jan. 21	40	21	3.7	1.58	107		3.5	450			Before meat diet.
" 25	40										
Feb. 1	43		3.5	1.70	92		3.6	455			
Mar. 7	39	19			100				43.5	56.5	
" 23	41	22	4.0	1.66	95	9.5	3.4	455			
Apr. 13	42	20	3.9	1.70	93	9.8			40	60	
" 23	40		4.5	1.82	111	9.9	3.9		43.2	56.8	
May 28	40	19	5.0	1.50	105	10.0			45	55	
June 25	41		5.3	1.49	91	9.6		460	45	55	
July 26	41		4.7	1.58	105		3.8				
Aug. 25	No analysis made, as subject had a pharyngitis.										
Sept. 25	33	18	4.3	1.49	96	10.0					
Oct. 25	38		4.4		100		3.3				
Nov. 26	39	20	3.0	1.50	105	10.2	3.9		47	53	
<i>1929</i>											
Jan. 9	41		3.2	1.58	105	10.0	3.7	455	40	60	
" 24	42	20			83.5		Fasted 20 hrs.				
Feb. 15	41		3.0	1.60	110						
Mar. 20	40										
	41										
	39	21	3.4	1.60	87	10.0	3.7	460			After general diet 4 wks.

CO<sub>2</sub>-combining power was determined because of the ketonuria and its probable effect on the alkali reserve. Analyses of sugar, plasma proteins, and chlorides were also included.

Specimens of blood were obtained before the meat diet was instituted. Thereafter specimens were drawn at monthly intervals and also at the close of the experiment. A portion of the

oxalated blood was at once precipitated. The remainder was centrifuged in graduated tubes for about 20 minutes. After determining the proportion of plasma to cells the former was drawn off and analyzed. About 10 cc. of whole blood were discharged into a test-tube and the serum was used for calcium determination.

TABLE II.

*Data Obtained on Subject K. A.*

Blood figures are expressed in mg. per 100 cc., CO<sub>2</sub>-combining power in volumes per cent.

Date.	Plasma proteins.	Albu-min.	Globu-lin.	Choles-terol.	A:G ratio.	CO <sub>2</sub> -combin-ing power.	Remarks.
<i>1928</i>							
Jan. 21						65.5	Before meat diet.
Feb. 1						59.4	
Mar. 7	6.95	4.21	2.74	600	1.53	60.0	
" 23	6.25	4.00	2.25	285	1.77	67.8	
Apr. 13	6.25	3.35	2.90	268	1.15	60.7	
" 23	6.77	4.24	2.53		1.65	66.2	
May 28	7.62	3.78	3.84	310	0.97	52.2	
June 25	7.27	4.21	3.06		1.38	60.1	
Sept. 25	7.00					61.0	
Nov. 26	7.12	4.12	3.00	500	1.37	56.0	
<i>1929</i>							
Jan. 9	6.85			400		54.1	
" 24				800			After 20 hr. fast.
Feb. 15	6.74			415		54.0	
Mar. 20	6.98			200		60.0	After general diet 4 wks.

Standard methods were employed. The Folin and Wu (3) system of analysis was used for the non-protein nitrogen, urea, creatinine, and sugar. Uric acid was determined by the method of Benedict (4). Calcium of the serum was analyzed by the procedure of Kramer and Tisdall (5) and the phosphorus of the plasma by the technique of Benedict and Theis (6). The CO<sub>2</sub>-combining power of the plasma was determined by the method of Van Slyke and Cullen (7). The technique of Bloor, Pelkan, and

Allen (8) was used for the cholesterol values of the plasma. The total proteins were determined by the macro-Kjeldahl method. 1 cc. of plasma was diluted to 50 cc. with 0.9 per cent sodium chloride and 25 cc. of the diluted plasma were used for each determination, which was made in duplicate. The albumin of the plasma was analyzed by the method of Howe (9). After

TABLE III.  
*Blood Figures of Subject V. S. Expressed in Mg. per 100 Cc.*

Date.	Non-protein N.	Urea.	Uric acid.	Creatinine.	Sugar.	Serum Ca.	Plasma P.	NaCl	R.B.C.	Plasma.	Remarks.
<i>1928</i>											
Feb. 17	50				117				per cent	per cent	
" 27	51	28	2.7	1.57	109			487	39	61	
Mar. 2	51		3.2	1.80					47	53	
" 16	53	29	3.7	1.80	100						
Apr. 20	52		4.7	1.60	115	11.0	3.4	460	41	59	
May 28	50	26	4.3	1.40	117	11.2	3.6		42	58	
June 25	48		4.7	1.43	100	9.6		470			
July 26	49		3.4	1.50	110						
Aug. 25	46	25	3.5	1.50	105		3.9		40	60	
Sept. 25	45		3.7	1.64	95	10.0	3.8				
Oct. 19	44	24	3.7	1.52	110			470			
Dec. 12	50	24	3.0	1.50	111	10.4	3.6	475	48	52	
<i>1929</i>											
Jan. 23	50		3.5	1.61	111				45	55	
Mar. 6	48	23	3.1	1.80	91						
Apr. 4	50	23	3.4	1.60	105	11.0	3.4	480	42	58	

precipitation of the globulins the nitrogen of the filtrate was determined by the macro-Kjeldahl technique.

Tables I to IV show the results, most of which are self explanatory. From the data it is apparent that the chemical composition of the blood of our subjects has been slightly affected by their diet. One of the subjects (V. S.) had an elevation of the non-protein nitrogen even before the meat diet was commenced, although urine analysis and other tests for renal function failed

to reveal any abnormalities. This high level was constant throughout the study. The blood uric acid of both men showed a rise of about 2 mg. per 100 cc. in the first 3 months, but returned to the normal at the end of that period even though the same diet was continued for about 5 months after the rise was observed.

The cholesterol values of both subjects were high. K.A. had a maximum of 800 mg. per 100 cc. on one occasion. This increase did not persist after the meat diet was discontinued and is there-

TABLE IV.  
*Data Obtained on Subject V. S.*

Blood figures are expressed in mg. per 100 cc., CO<sub>2</sub>-combining power in volumes per cent.

Date.	Plasma proteins.	Albu- min.	Globu- lin.	Choles- terol.	A:G ratio.	CO <sub>2</sub> - combin- ing power.	Remarks.
<i>1928</i>							
Feb. 27	6.44	4.41	2.03	263	2.17	56.0	Before meat diet.
Mar. 2	6.54	4.41	2.13	315	2.08	60.0	
Apr. 20	6.25			307		68.1	
May 28	6.69	3.62	3.07	286	1.18	58.9	
June 25	6.81	3.64	3.17		1.15	58.9	
Aug. 25	6.70	3.52	3.18	300	1.11		
Oct. 19	6.70	3.58	3.12		1.14	60.1	
Dec. 12	6.65	3.60	3.05	226	1.19	53.2	
<i>1929</i>							
Jan. 23				235			After general diet 2 wks.
Mar. 6	6.87	3.62	3.25	212	1.18	55.1	
Apr. 4	6.69	3.58	3.12	218	1.14	59.0	

fore to be attributed to the large quantity of ingested fat. A visible lipemia was likewise noted.

During the consumption of large quantities of fat a ketonuria was present. The ketone bodies excreted varied from 0.5 to 10 gm. (2) daily, and might be expected to reduce the alkaline reserve; nevertheless the CO<sub>2</sub>-combining power remained within normal limits. In spite of the constant excretion of ketone bodies in the urine the subjects at no time showed evidence of ketone intoxication either clinically or by laboratory tests.

## SUMMARY.

1. Two healthy men lived exclusively for 1 year on lean and fat meat.
2. The chemical composition of the blood was little affected by such a diet except for a lipemia and hypercholesterolemia. These returned to normal when the diet was discontinued.
3. The uric acid content rose and after about 3 months fell although the diet was continued for 5 months after the elevation had been noted.
4. The CO<sub>2</sub>-combining power remained within normal limits in spite of the daily ketonuria over the entire period of the experiment.
5. There were no changes in the constituents of the blood that might suggest that renal damage had occurred.

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