THE EFFECT OF FOOD STIMULI UPON THE QUANTITY OF LEUKOCYTES IN HUMANS

COMMUNICATION II. THE DEPENDENCE OF CONDITIONED AND COMPLEX REFLEX FOOD LEUKOCYTOSIS ON FOOD EXCITABILITY AND ON THE INITIAL LEVEL OF LEUKOCYTOSIS*

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Our studies of the effect of various kinds of food on conditioned and complex reflex food leukocytosis have shown that both types of leukocytosis are more pronounced with the ingestion of sausage, salted herring, and vegetable soup (with meat or fish) than with the ingestion of white bread or pastry, especially the latter. At the same time, we found that this correlation could not always be observed. In some cases, conditioned and complex reflex food leukocytosis did not appear with the use of the first three food stimuli, but were clearly evident with the use of the last two.

This article analyzes some of the reasons for this discrepancy between the kinds of food stimuli and the degree to which the experimental forms of leukocytosis are expressed.

Analyzing the factors influencing the two types of leukocytosis with the use of different kinds of food, we turned our attention to the significance of food excitability in the experimental subjects. It has, for example, been shown that acute inhibition of food excitability is present, in some cases, both forms of leukocytosis are absent with the use of sausage, herring,and vegetable soup, as well as with the use of bread or pastry. When food excitability is comparatively high, however, even white bread or pastry can often cause marked conditioned and complex reflex food leukocytosis.

EXPERIMENTAL RESULTS

The table gives the results obtained in our study of these two types of leukocytosis under two sets of conditions: under conditions of heightened food excitability on the one hand, and under conditions of average or diminished food excitability on the other.

The effect of the status of food excitability on the experimental types of leukocytosis could be judged by comparing the data obtained from the subjects with heightened food excitability with the data from subjects with diminished food excitability. In the first case, both types of leukocytosis were usually present with the use of the most different kinds of food, while in the second case, both types were often absent. Thus, for example, in N-na, a 53-year-old subject, food excitability was remarkably high, as the subject herself confirmed, saying she had always been noted for "my good appetite". We also made observations on I-n, 35 years old, who usually ate the food set before him without any particular appetite. In the case of N-na, conditioned food leukocytosis was found in 16 out of 21 experiments and complex reflex leukocytosis 18 times. In I-n, the first type of leukocytosis was observed in 10 out of 21 experiments, the second type, in 15.

This dependence of conditioned and complex reflex food leukocytosis on the condition of food excitability was consistently observed in repeated observations on the same experimental subjects. As an illustration of

* The terms "conditioned and complex reflex" as in original text – Publishers.

Effect of Food Excitability on Food Leukocytosis

Type of food	Condition of food excitability	Number of subjects	Food leukocytosis			
			conditioned		complex reflex	
			present	absent	present	absent
Sausage	Heightened	36	32	4	33	3
	Average or diminished	11	4	7	4	7
Herring	Heightened	29	24	5	22	7
	Average or diminished	9	1	8	6	3
Vegetable soup	Heightened	15	13	2	15	–
	Average or diminished	16	2	14	12	4
White bread	Heightened	13	11	2	11	2
	Average or diminished	35	6	29	10	25
Pastry	Heightened	26	9	17	17	9
	Average or diminished	6	1	5	3	3

this, we cite the data obtained from observations on Gr-va, 18 years old, who constantly complained of her lack of appetite. However, she appeared for 2 of the 10 investigations after taking a long afternoon walk and ate the food she was given with great pleasure (both times, tea and a piece of white bread). In both of these 2 cases, the white bread caused both conditioned and complex reflex food leukocytosis, while with the sausage and herring eaten in other experiments, the first type of leukocytosis was often absent, and the second only weakly expressed (especially with the sausage).

Another important factor to be considered in order to explain the nonconformity of the experimental types of leukocytosis with the kind of food eaten is the original level of leukocytosis. We found, for example, that if there was an increase in the total number of white blood corpuscles before the food was exhibited or eaten, either a slight increase or even inhibition of both types of leukocytosis was usually observed.

Figure 1 shows the percentage of investigations in which conditioned and complex reflex food leukocytosis appeared in relation to the original levels of leukocytosis. This graph shows that these two forms of leukocytosis appeared less often as the original level of white blood corpuscles increased. More specifically, conditioned food leukocytosis was observed in 84% of the investigations with an original level of 3000-5000 leukocytes per 1 mm^3, and complex reflex leukocytosis, in 94%. The first type of leukocytosis was observed in only 21% of the investigations in which the initial leukocyte level was 9000-11,000 per 1 mm^3, however, and the second type, in 44%.

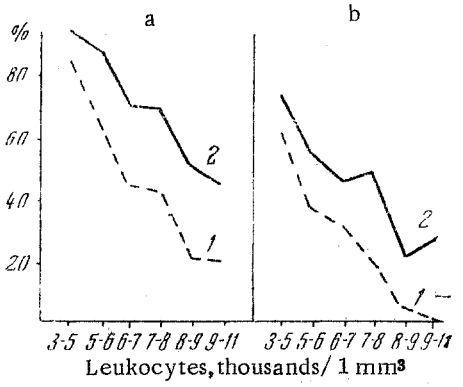

Fig. 1. Degree of increase in conditioned and complex reflex food leukocytosis. a) More than 1% of the original level of leukocytes; b) more than 25% of the original level of leukocytes; 1) complex reflex food leukocytosis; 2) conditioned food leukocytosis.

The importance of the original level of white blood corpuscles in determining the character of the conditioned and complex reflex food leukocytosis was also shown by repeated investigation of leukocytosis during the exhibition and intake of food. Leukocytosis was examined 2-3 and 4-5 minutes after eating began, in the same experimental subjects. These determinations showed that the greater the increase in leukocytosis shown by the first blood sample (as compared with the original level of leukocytes), the more leukocytosis in the second blood sample decreased (with both the exhibition and eating of food).

Figure 2 shows the percentage of investigations in which the total number of leukocytes in the second blood sample taken was observed to have decreased, depending

Fig. 2. Data from investigation of conditioned (a) and complex reflex (b) food leukocytosis.

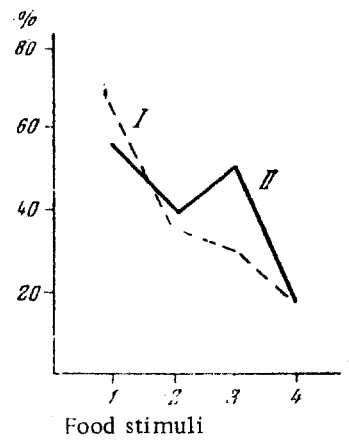

Fig. 3. Number of investigations in which conditioned (I) and complex reflex (II) food leukocytosis were inhibited by the influence of different food stimuli.

on the degree to which leukocytosis had been enhanced in the first sample taken – less than 10%, 11-20%, 21-30% and over 30% of the leukocytosis present before the exhibition of the food.

There was a substantial difference between the percentage of investigations with leukocytosis increased by less than 10% in the first blood sample in which leukocytosis decreased in the second sample and the corresponding percentage of investigations in which leukocytosis was more than 30% higher in the first sample than the original level. In the latter case, the percentage of the investigations showing a decrease, as the curves in Figure 2 show, was almost twice as large as in the former case (this was true for both types of food leukocytosis). The results of our observations on the influence of the original level of white blood corpuscles on food leukocytosis in people coincide with the data which have been obtained with animals [4 et al.]

According to K. M. Bykov [1], the activity of various internal organs is usually inhibited by the action of positive cortical impulses on these organs during their activity. There is every reason to consider the decrease which occurred in conditioned and complex reflex food leukocytosis when the original leukocyte level was high in the light of the proposition expressed by K. M. Bykov.

A series of works have demonstrated that the inhibition of a given organ's activity caused by different influences depends not only on the intensity of the organ's activity at the time, but also on the strength of the influential factors. To a certain extent, our research confirmed these observations. It was found, for example, that when the initial level of white blood corpuscles was comparatively high, the influence of such food stimuli as sausage, herring and vegetable soup caused a more rapid inhibition of conditioned and complex reflex food leukocytosis than did the intake of white bread alone, which was eaten by the subjects reluctantly. Figure 3 illustrates this by means of curves showing the percentage of investigations in which the two types of leukocytosis became inhibited with the subject's intake of sausage (1), herring (2), vegetable soup (3) and white bread (4). The original leukocytosis was over 8000 per 1 mm³ in all of these cases.

The data we have presented clearly show that the type of food ingested must be taken into account, as well as the amount of leukocytosis, when estimating the reasons for decreased conditioned and complex reflex food leukocytosis under conditions of a relatively high initial level of leukocytes.

SUMMARY

This work presents data concerning the effect of different food excitability ("appetite") as well as of the initial level of leukocytosis on the conditioned and complex reflex food leukocytosis. In presence of increased food excitability, the conditioned and complex reflex food leukocytosis is much more pronounced than when this excitability is decreased. The degree of both types of leukocytosis also depends on such an important factor as the initial level of white blood cells. It was shown that with comparatively high initial values of leukocytosis, the absence of conditioned and complex reflex food leukocytosis is much more common than with a low level of white blood cells (even in the presence of high food excitability). Depression of these forms of leukocytosis in cases of increased initial level of white blood cells is especially pronounced with the action of

food stimuli such as sausage, salted herring and vegetable soup.

LITERATURE CITED

[1] K. M. Bykov, The Cerebral Cortex and the Internal Organs,* Moscow (1954).

[2] I. P. Pavlov, Complete Collected Works,* v. II, Book 2, Supplemented Edition, Izd. AN SSSR (1951).

[3] I. P. Pavlov, Complete Collected Works,* v. III, Book 1, Izd. AN SSSR (1951).

[4] V. N. Chernigovskii and A. Ia. Iaroshevskii, Problems of the Nervous Regulation of the Blood System,* Moscow (1953).

* In Russian.