ИНСТИТУТ
ЯДЕРНОЙ ФИЗИКИ СОАН СССР

ПРЕПРИНТ И Я Ф 75-11

B.G.Konopel'chenko, Yu.B.Rumer

CLASSIFICATION OF THE CODONS OF THE GENETIC CODE. II.

Новосибирск
1975

CLASSIFICATION OF THE CODONS
OF THE GENETIC CODE . II .

B.G.Konopel'chenko, Yu.B.Rumer

Institute of Nuclear Physics, Novosibirsk 90,
USSR

A b s t r a c t

The classifications of the codons in which a break-up of 16 roots into two octets occurs are considered.

CLASSIFICATION OF THE CODONS
OF THE GENETIC CODE . II .

B.G.Konopel'chenko, Yu.B.Rumer

In the previous paper [1] we have considered the properties of the system of the codons from the viewpoint of a classification of the roots into strong and weak.

In the present paper we will consider anothers possible classifications and will state a hypothesis of the break-up of 16 roots into two octets with respect to any property of the system of the codons.

In the paper [2] it was shown that all 20 amino-acids break into two groups-polar (hydrofilic) and nonpolar (hydrofobic). It turned out that polarity and nonpolarity of amino-acids are independent from the termination |Z) of the codon (XY|Z), i.e. it is completely determined by the root (XY| . As a result we have two octets of roots [2] :

Table 1

nonpolar	polar
CC	AA
GC	UA
GG	GA
UG	CA
CU	AG
GU	CG
UU	AC
AU	UC

The roots in table 1 are disposed in such a way to emphasize a break-up of each of the octets (by the last letter) into quartet and two doublets. We note that in the nonpolar octet five roots are strong and three roots are weak and in the polar octet three roots are strong and five roots are weak.

The break-up of 16 roots into two octets is found also when we consider such a characteristic of amino-acid as her polar dependence [3] :

1	Polar dependence R_m	2	Polar dependence R_m
CC	6.6	CA	8.5
GC	7.0	GA	12.7
UC	7.5	UA	5.4
AC	6.6	AA	10.
CU	4.9	CG	9.1
GU	5.6	GG	7.9
UU	5.0	UG	5.0
AU	5.1	AG	8.3

Table 2

The value R_m for the root (XY| we determine as arithmetical mean of R_m for all codons with the root (XY| .

The roots of the second octet are characterized by the larger values of R_m in comparison with the roots of the first octet. The anomalous values of R_m for the roots (UA) and (UG) are probably related with the fact that the codons (UA|G), (UA|A) and (UG|A) are nonsences.

We see that the octets in the table 2 possesses a regular structure. In the first octet the second letter (Y) is a pyrimidine (C or U) and in the second octet - a purine (G or A). Each of the octets break up into two quartets and the roots within each quartets are characterized by near values of polar dependence R_m . Then under substitution C↔A, G↔U the octets transform one into another. We note also that in the first octet there are six strong roots and two weak roots. In the second octet two roots are strong and six are weak.

The common feature of all classifications of roots considered - strong - weak, nonpolar - polar , by values of polar dependence is the break-up of 16 roots into two octets which in its turn decomposes into quartets, doublets an so on.

The break-up of 16 roots into two octets seems to us a fundamental property of the system of codons. In this connection it is natural to formulate a <u>hypothesis:</u> 16 roots of the codons break up into two octets with respect to any property of the system of codons.

This hypothesis states a correspondence between the properties of the system of codons and decompositions of the roots into octets. It seems that to most decompositions of all roots into two octets correspond the classifications of the codons with respect to some properties.

There exists a large number of ways by which we may to decompose 16 roots into two octets and therefore it seems that we have a large number of correspondent properties of the system of the codons.

Here we will give some examples of possible break-ups of roots into octets.

Example 1

1	2
CC	AA
GC	UA
UC	GA
CG	AU
GG	UU
AG	CU
GU	UG
CA	AC

Table 3

We see that under substitution C↔G, A↔U each of the octets is transformed into himself. Since this substitution of letters transform codons into anticodons then each of the octets contains codon roots and corresponding anticodon roots.

Under substitution C↔A, G↔U the octets are transformed one into another. In table 3 we noted also the break-up of each of the octets into two triples and two singlets.

Example 2

1	2
CC	AA
GC	UA
UC	CA
CG	AU
GG	UU
AG	GU
CU	UG
GA	AC

Table 4

In the table 4 each of the octets is transformed into himself under substitution C↔G, A↔U analogous to the example 1. The octets in table 4 are remarkable also by the fact that each of them transforms into himself under permutation of letters in the root (i.e. (XY)→(YX)). Further if one groups the roots in each of these octets into triples and singlets with respect to first letter, then they will coincide with triplets and singlets of the octet with permutated letters.

Besides two examples considered above one can form a large number of others. A method of construction of pairs of octets with requiring properties is obvious.

The determination of the properties of the system of codons which correspond to such decompositions into octets is important and nontrivial.

The authors are grateful to A.A.Prokopenko for numerous discussions.

R e f e r e n c e s

1. B.G.Konopel'chenko, Yu.B.Rumer, Classification of the codons of the genetic code.I. Previous paper.
2. M.V.Volkenstein, Biochim et Biophys.Acta, 119, (1966).
3. Woese C.R., Dugre D.H., Dugre S.A., Kondo M., Saxinger W.C., in Cold Spring Harbor Symp.Quant.Biol., 31, 723 (1966).