Chemistry of Natural Compounds, Vol. 41, No. 1, 2005

EFFECT OF NATURAL PHYSIOLOGICALLY ACTIVE SUBSTANCES ON EUCARYOTIC CELL NUCLEI

O. Kh. Saitmuratova

UDC 612.591.04

Nuclear protein synthesis has been investigated mainly in nuclei of Hela, liver, thymus, and human brain with a few studies in plants [1-6]. A small quantity of proteins is synthesized by cellular nuclei [7] and makes up 0.4-0.8% of the total cellular protein.

We have previously studied nuclear synthesis, isolated for the first time two proteins that are glycoproteides of molecular weight 14 and 27 kDa [8], and studied their physiological role [9].

Our goal was to screen natural compounds that affect nuclear synthesis. The investigations were carried out in cellular nuclei of cotton-seed sprouts and rabbit brain. Nuclei were isolated using literature methods [4, 9]. Nuclear protein synthesis was estimated from ^{14}C lysine incorporation [9].

The investigations have found that benzylaminopurine (BAP) at concentrations of 10^{-5} and 10^{-6} M, the BAP complex with cytokinin-binding protein (CBP) at a concentration of 10^{-5} M, and indoleacetic acid (IAA) at concentrations of 10^{-3} and 10^{-4} M have no effect on ^{35}S-methionine incorporation into cotton nuclear proteins.

Proteinkinase C, which is isolated from cotton, increases protein biosynthesis by 40 and 55% at concentrations of 50 and 100 µg/mL compared with a control. However, total lectin-like proteins (LLP) at concentrations of 50, 100, and 200 µg/mL suppress protein biosynthesis depending on dose by 28, 48, and 65%, respectively. Lactose-specific LLP more noticeably suppress nuclear protein synthesis. Extensin-like proteins (ELP) are the strongest inhibitors among the studied compounds. At concentrations of 10, 50, and 100 µg/mL, they inhibit incorporation of label by 28, 70, and 81%, respectively.

Pix (retardant), which is used for stamping and to accelerate ripening of cotton bolls, also stimulates protein biosynthesis depending on dose. The maximal stimulating dose is 100 µg/mL (38%) compared with a control. T-85, a new Zn-containing defoliant, decreases protein synthesis at doses of 5 and 10 µg/mL.

We also studied the effect of the natural compounds polyprenols, PAV-1, and OGS-5, preparations based on cotton soap stocks, which are used as a solution (0.1%) for spraying cotton and vegetables (tomato, cucumber) to increase their growth, development, and production.

Results of in vitro experiments indicate that adding preparation to the incubation medium at a dose of 100 µg/mL increases the synthesis rate up to 49%. A study of PAV-1 and OGS-5 at doses of 10, 50, and 100 µg/mL found a dose-dependent reduction of synthesis rate for PAV-1 and a dose-dependent increase of protein synthesis rate for OGS-5.

It should be noted that these natural substances increase substantially the protein synthesis rate if cotton seeds are soaked in an in vivo system rather than an in vitro one [5, 6, 10].

Thus, experiments determining the activities of the studied compounds showed that cotton glycoproteides (LLP and ELP) were strong inhibitors whereas the synthetic cytokinin BAP is a weak activator of nuclear protein synthesis. The different nature of the biological activity of LLP and ELP has been discussed relative to structural features of the carbohydrate units in the glycoproteides.

Next we studied the effect of various classes of substances on the activity of animal nuclei. The proteinaceous toxin ricin (600.60 and 6 µg/mL) and glycoproteides synthesized and isolated from nuclei of rabbit brain cells at concentrations of 5, 10, 20, and 30 µg/mL gradually suppress the ability of nuclei to synthesize protein. It is important to note that nuclear glycoproteide is a good inhibitor of this process.

A. S. Sadykov Institute of Bioorganic Chemistry, Academy of Sciences of the Republic of Uzbekistan, Tashkent, fax (99871) 162 70 71. Translated from Khimiya Prirodnykh Soedinenii, No. 1, pp. 90-91, January-February, 2005. Original article submitted August 28, 2004.

0009-3130/05/4101-0111

The alkaloids that we used (lycorine, lupinine, and anabasine hydrochloride) and synthetic anabasinyl-O-isopropyl phosphorous acid at all concentrations activate nuclei toward protein synthesis. Lupinine was the most active. Peptides in addition to nuclear glycoproteides (enkephalin, epithalamin, and ACTH [4-7]) and nitrocompounds (nitroglycerine and nitrocel) increase the activity of nuclei for protein synthesis. It should be mentioned that nitrocel has a strong activating effect (88%). The remaining compounds (neuro- and psychotropic substances, batriden, and acetylcholine) decrease protein synthesis.

Thus, the investigation of the biological activity of several preparations on nuclear functioning found that alkaloids and peptides stimulate whereas LLP and ELP and nuclear glycoproteides inhibit the functional capability of eucaryote nuclei. It must be emphasized that the preparations we used affect nuclear protein synthesis regardless of structure and dose because nuclei lack ribose-type transcriptional and translational structures.

ACKNOWLEDGMENT

We express our sincere gratitude to staff of the Tashkent PMI and the Institute of Bioorganic Chemistry of the Academy of Sciences of the Republic of Uzbekistan for supplying the preparations.

REFERENCES

1. A. R Dravid and E. Wong, *J. Neurochem.*, **19**, 2707 (1978).
2. M. L. Birnstil and B. B. Hyde, *J. Cell Biol.*, **18**, 41 (1963).
3. S. M. Durmishidze and D. I. Dzhokhadze, *Dokl. Akad. Nauk SSSR*, **242**, No. 2, 453 (1988).
4. O. Kh. Saitmuratova and O. G. Nemtsova, *Dokl. Akad. Nauk Resp. Uzb.*, No. 12, 43 (1988).
5. A. M. Rashkes, O. Kh. Saitmuratova, N. K. Khidyrova, V. B. Leont′ev, and Kh. M. Shokhidoyatov, *Khim. Prir. Soedin.*, 65 (1988).
6. N. K. Khidyrova, N. Mamatkulova, Kh. M. Shokhidoyatov, and O. Kh. Saitmuratova, *Khim. Prir. Soedin.*, 354 (2002).
7. W. P. Allen and F. H. Witt, *Exp. Cell. Res.*, **97**, 151 (1975).
8. O. Kh. Saitmuratova, I. S. Khazbievich, and S. Kh. Nasyrov, *Dokl. Akad. Nauk Uzb. SSR*, No. 9, 46 (1986).
9. O. Kh. Saitmuratova et al., *Neirokhimiya*, **6**, No. 3, 360 (1987).
10. O. Kh. Saitmuratova, *Uzb. Biol. Zh.*, No. 5, 3 (1991).