PROTEINS OF CHICKEN, DUCK, AND TURKEY EGG WHITE

by

L. R. MACDONNELL, E. D. DUCAY, T. F. SUGIHARA AND R. E. FEENEY

Western Regional Research Laboratory, Albany, Calif. (U.S.A.)*

In the course of our studies on the chemical properties and biological activities of the proteins of chicken egg white, it became important to study the comparative biochemistry of the egg whites of other avian species. Electrophoretic comparisons of various avian egg whites have been made by BAIN AND DEUTSCH[1], and SMOLELIS AND HARTSELL[2] have reported on the comparative lysozyme contents of different whites as determined bacteriologically. In both studies large differences between species were found.

We are reporting on the comparative contents of lysozyme (bacteriolytic activity)[3], conalbumin (chemical iron-binding capacity)[3], ovomucoid (trypsin-inhibiting capacity)[3], and cysteine (*p*-chloromercuribenzoate titration for sulfhydryl groups)[3,4] of several species. Table I summarizes the average values of many chicken whites and of duplicate pooled samples of turkey, Peking duck, and Mallard duck egg white. The lysozyme contents are comparable with those reported by SMOLELIS AND HARTSELL[2] The relative conalbumin contents are of the same order as reported by BAIN AND DEUTSCH[1], but lower amounts and greater differences between species were found. The ovomucoid contents of the duck whites were higher than those of turkey or chicken.

TABLE I

Data in percentage, dry-weight basis*

Bird	*Lysozyme*	*Conalbumin*	*Ovomucoid*	*Cysteine*	
				Native	*Denatured***
Chicken***	3.4	12	11	0.46	0.62
Turkey†	1.84	11	11	0.42	0.47
Peking duck†	0.94	2.8	15	0.32	0.37
Mallard duck†	0.86	2.9	15	0.28	0.29

* Standards previously described[3].
** Guanidine-HCl as previously described[4].
*** Averages from 12 or more different pooled samples (4 to 8 individual egg whites).
† Averages of duplicate pooled samples.

An important difference between the whites was found in the sulfhydryl, or cysteine, contents. In chicken egg white, all the cysteine exists in the ovalbumin component and the values found have been shown to be equivalent to three sulfhydryl groups per mol in the native protein and four in the denatured[4]. The large increase in sulfhydryl groups in the chicken egg white after denaturation was not observed in the other whites (Table I). These results may be interpreted as a demonstration of different molecular structure in the turkey and duck ovalbumins as compared to those of chicken. One preparation of semipurified turkey ovalbumin gave identical sulfhydryl titrations before and after denaturation, thus confirming the results found on the turkey white. Also, from the ovalbumin contents reported by BAIN AND DEUTSCH[1] and on the assumption that the ovalbumins of the other species have molecular weights similar to the chickens' (46,000 ± 10%), one can calculate three sulfhydryl groups per mol for turkey ovalbumin and two per mol for duck ovalbumin.

Studies of this nature must be carefully appraised with regard to the methods and assumptions employed. The reported results are in terms of the proteins of chicken white as standards and large differences in molecular weights and specific activities may exist. Further studies on the comparative anti-hemagglutinin activities and the culinary and foaming properties of the various egg whites will be reported elsewhere.

* Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U.S. Department of Agriculture.

REFERENCES

1 J. A. BAIN AND H. F. DEUTSCH, *J. Biol. Chem.*, 171 (1947) 531.
2 A. N. SMOLELIS AND S. E. HARTSELL, *Proc. Soc. Exptl. Biol. Med.*, 76 (1951) 455.
3 R. E. FEENEY, E. D. DUCAY, R. B. SILVA AND L. R. MACDONNELL, *Poultry Sci.*, 31 (1952) 639.
4 L. R. MACDONNELL, R. B. SILVA AND R. E. FEENEY, *Arch. Biochem. Biophys.*, 32 (1951) 288.

Received October 12th, 1953

THE METABOLISM IN THE RAT OF GUANYLIC ACID LABELLED WITH ^{32}P*

by

PAUL M. ROLL, HERBERT WEINFELD AND GEORGE BOSWORTH BROWN

The Laboratories of the Sloan-Kettering Institute for Cancer Research, New York 21, N.Y. (U.S.A.)

It has been established that, in the rat, guanine and guanosine are very poor precursors but that guanylic acids serve as effective precursors of pentose nucleic acid (PNA). For example, no incorporation of guanine[1,2] or guanosine[3], labelled with ^{15}N, into the PNA guanine of the combined organs of the viscera of the rat could be detected, although subsequent investigations with these compounds, labelled with the more sensitive tracer ^{14}C, revealed that each was incorporated to a slight extent[4,5]. In contrast, it was found that the PNA guanine of the rat viscera was extensively derived from yeast guanylic acid, which was presumably a mixture of guanylic acids "a" and "b"[6] (currently considered to be the 2' and 3'-isomers) and later it was shown that the "b" isomer was well incorporated[7]. It must be noted that in all of the above studies only the guanine moiety of the administered nucleosides and nucleotides had been labelled so that only this portion of the molecule was traced. However, the results of the experiments do demonstrate that guanine in nucleotide linkage is much more extensively utilized than is the purine, and it may be concluded that the mechanism for the incorporation of guanylic acids does not involve a simple liberation of either the nucleoside or the free purine prior to the incorporation. A possible mechanism would involve the incorporation of the intact nucleotides during the biosynthesis of the PNA. To test this possibility, guanylic acids "a" and "b" were prepared which were labelled uniformly with ^{15}N, uniformly with ^{14}C and with ^{32}P and were administered to rats. The results of the utilization of the phosphorus of these nucleotides are presented here.

The preparation of the multiply labelled guanylic acids was carried out by isolating the nucleotides by ion exchange on Dowex-1[8] (National Aluminate Corporation, U.S.A.) from hydrolysates of nucleic acids labelled with ^{14}C**, ^{15}N[9] and ^{32}P. The ^{32}P labelled nucleic acid was isolated by sodium chloride extraction from yeast which had been grown in a medium containing ^{32}P*** and was purified by precipitation from aqueous solution with glacial acetic acid. The three separately labelled samples of each nucleotide were combined and were administered to male Sherman strain rats of 250–300 g by intraperitoneal injection. Each rat received 0.4 m*M* per kilogram of body weight in three equal doses at about two-hour intervals, and the animals were sacrificed approximately twenty-four hours after the first injection. The spleen, liver, kidneys, testes and small intestine were removed and were frozen on dry-ice. The tissues were combined and were homogenized in ice-cold 10% trichloroacetic acid (TCA). The residue was dehydrated with alcohol and ether to yield a dry tissue powder from which ribonucleotides were obtained by a modification of the SCHMIDT-THANNHAUSER procedure[10] and were separated by ion exchange on Dowex-1.

Samples of the solutions of the nucleotides were plated on aluminum planchets and the activity due to ^{32}P was determined in an internal Geiger-Müller flow counter (Radiation Counter Laboratories, mark 12, model 1, helium-*iso*butane gas), with the use of an aluminum shield which had been found

* This investigation was supported by grants from the National Cancer Institute, National Institutes of Health, United States Public Health Service, from the Atomic Energy Commission, Contract No. AT(30-1)-910, and from the Nutrition Foundation, Inc.

** Obtained from Schwarz Laboratories, Inc., New York, U.S.A.

*** Obtained from Oak Ridge National Laboratory, Tennessee, U.S.A., as inorganic phosphate.