1). In matings with HfrH clone homogeneity increases with incubation time from a value of about 50 percent to 100 percent in approximately 140 minutes or about four divisions of the recipient parent. In view of the fact that 90 percent of the clones produced from matings from the Cavalli strain are homogeneous with no incubation, the resolution of this type of experiment is inadequate to study the kinetics of segregation in this strain.

These two types of experiments suggest that DNA synthesis is required in the recipient parent if a multiplicity of recombinant classes per zygote greater than two is found regardless of whether recombination occurs via copy-choice, break-and-reunion, or a combination of the two. The studies reported here with HfrC indicate that generally only one recombinant type is produced per zygote, a result consistent with the earlier studies of Lederberg (*1*) and of Tomizawa (*3*). Less complete studies with other Hfr strains (AB735, Hfrl, and Ral) indicate that the segregational pattern of the Cavalli strain is typical of these strains and that the Hayes strain may be considered to have the aberrant behavior.

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References and Notes

1. J. Lederberg, *Proc. Nat. Acad. Sci. U.S.* **43**, 1060 (1957).
2. T. F. Anderson, *Cold Spring Harbor Symp. Quant. Biol.* **23**, 47 (1958).
3. J. Tomizawa, *Proc. Nat. Acad. Sci. U.S.* **46**, 91 (1960).
4. T. H. Wood and H. Marcovich, *Genetics* **49**, 779 (1964).
5. P. G. de Haan and C. Verhoef, *Mutation Res.* **3**, 111 (1966).
6. A. B. Oppenheim and M. Riley, *J. Mol. Biol.* **20**, 331 (1966).
7. O. H. Siddiqi, *Proc. Nat. Acad. Sci. U.S.* **49**, 589 (1963).
8. E. L. Wollman, F. Jacob, W. Hayes, *Cold Spring Harbor Symp. Quant. Biol.* **21**, 141 (1956); T. H. Wood and R. H. Walmsley, unpublished.
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Human Growth Hormone and Placental Lactogen: Structural Similarity

Abstract. *Sequential analysis of the first 17 amino acids from the amino-terminus of human placental lactogen reveals similarity to the sequence of human growth hormone, 11 of the residues being identical.*

The similar immunologic and biologic properties of human growth hormone (HGH) and placental lactogen (HPL) led us to look for structural similarities. The molecular weight of HGH is 21,500 (*1*), and the complete amino acid sequence has been reported (*2*).

A purified preparation of HPL for structural analysis was isolated from human term placentas by salt extraction, ethanol precipitation, gel filtration, isoelectric precipitation, and ion-exchange chromatography (*3*); it was homogeneous on gel filtration, disc electrophoresis, and analytical ultracentrifugation. The COOH-terminal amino acid was phenylalanine, the NH_2-terminal sequence was H-Val-Gln-, and the amino acid composition was similar to that of HGH.

The molecular weight of the hormone, as determined by ultracentrifugation, is reported to be 37,500 (*4*) and 39,000 (*3*), whereas the minimum molecular weight calculated from quantitative NH_2-terminal data is 21,500 (*3*). Ultracentrifugal studies of HPL have shown evidence of the presence of a monomer having a molecular weight of 18,600 (*4*).

These findings suggested that the HPL molecule may be chemically related to HGH. To further examine this possibility we have determined the sequence of the first 17 residues from the NH_2-terminus, using the protein sequenator of Edman and Begg (*5*). The purified HPL (7 mg) was directly subjected to degradation in the sequenator by use of the technique described for myoglobin (*5*).

Each degradation cycle produced one main amino acid component and a very faint second component. We present the sequence of the major component, with the NH_2-terminal structure of HGH (*2*) for comparison:

HPL: H-*Val*-*Gln*-Thr-*Val*-Pro-Leu-Ser-Arg-
HGH: H-*Phe*-*Pro*-Thr-*Ile*-Pro-Leu-Ser-Arg-
1 2 3 4 5 6 7 8
Leu-Phe-Asp-*His*-Ala-Met-Leu-*Gln*-*Ala*-
Leu-Phe-Asp-*Asn*-Ala-Met-Leu-*Arg*-*Ile*-
9 10 11 12 13 14 15 16 17

In this sequence of 17 amino acids from the NH_2-terminus of HPL, a total of 11 are identical with those occupying the same position in the HGH molecule. Such extensive similarity between the two hormones establishes beyond doubt a structural relation providing a basis for the well-documented immunologic and biologic similarities of HGH and HPL (*6*). Our results support the proposal that the HPL monomer consists of a single peptide chain with considerable similarity to HGH.

The minor component of each cycle had a sequence identical with that of the main component, with the exception that the NH_2-terminal sequence H-Val-Gln- was missing. The presence of such a "shortened" molecule in the preparation is interesting in view of the suggestion (*7*) that the two unidentical chains of bovine growth hormone may differ only by the absence of a small NH_2-terminal peptide.

Further sequence studies of HGH and HPL should provide structural explanations for the differences in potency of the antigenic, lactogenic, and somatotrophic properties that are shared by these molecules. The production of similar proteins by such diverse cells as the pituitary acidophils and the placental syncytiotrophoblast (*8*) doubtless reflects a biochemical need analogous to that which evokes the production of chorionic gonadotrophin by the placenta to maintain the corpus luteum of pregnancy. However, since the function of HPL has not been fully elucidated, the nature of this need remains unapparent.

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References and Notes

1. C. H. Li and B. Starman, *Biochim. Biophys. Acta* **86**, 175 (1964).
2. C. H. Li, W.-K. Liu, J. S. Dixon, *J. Amer. Chem. Soc.* **88**, 2050 (1966).
3. K. J. Catt, B. Moffat, H. D. Niall, B. N. Preston, *Biochem. J.* **102**, 27C (1967).
4. J. R. Florini *et al.*, *Endocrinology* **79**, 692 (1966).
5. P. Edman and G. Begg, *European J. Biochem.* **1**, 80 (1967).
6. J. B. Josimovich and J. A. MacLaren, *Endocrinology* **71**, 209 (1962); S. L. Kaplan and M. M. Grumbach, *J. Clin. Endocrinol.* **24**, 90 (1964); H. Friesen, *Endocrinology* **76**, 369 (1965).
7. E. Marler, G. J. Ellis, A. E. Wilhelmi (unpublished), cited by J. B. Mills, dissertation, Emory University (1965).
8. J. J. Sciarra, S. L. Kaplan, M. M. Grumbach, *Nature* **199**, 1005 (1963).
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