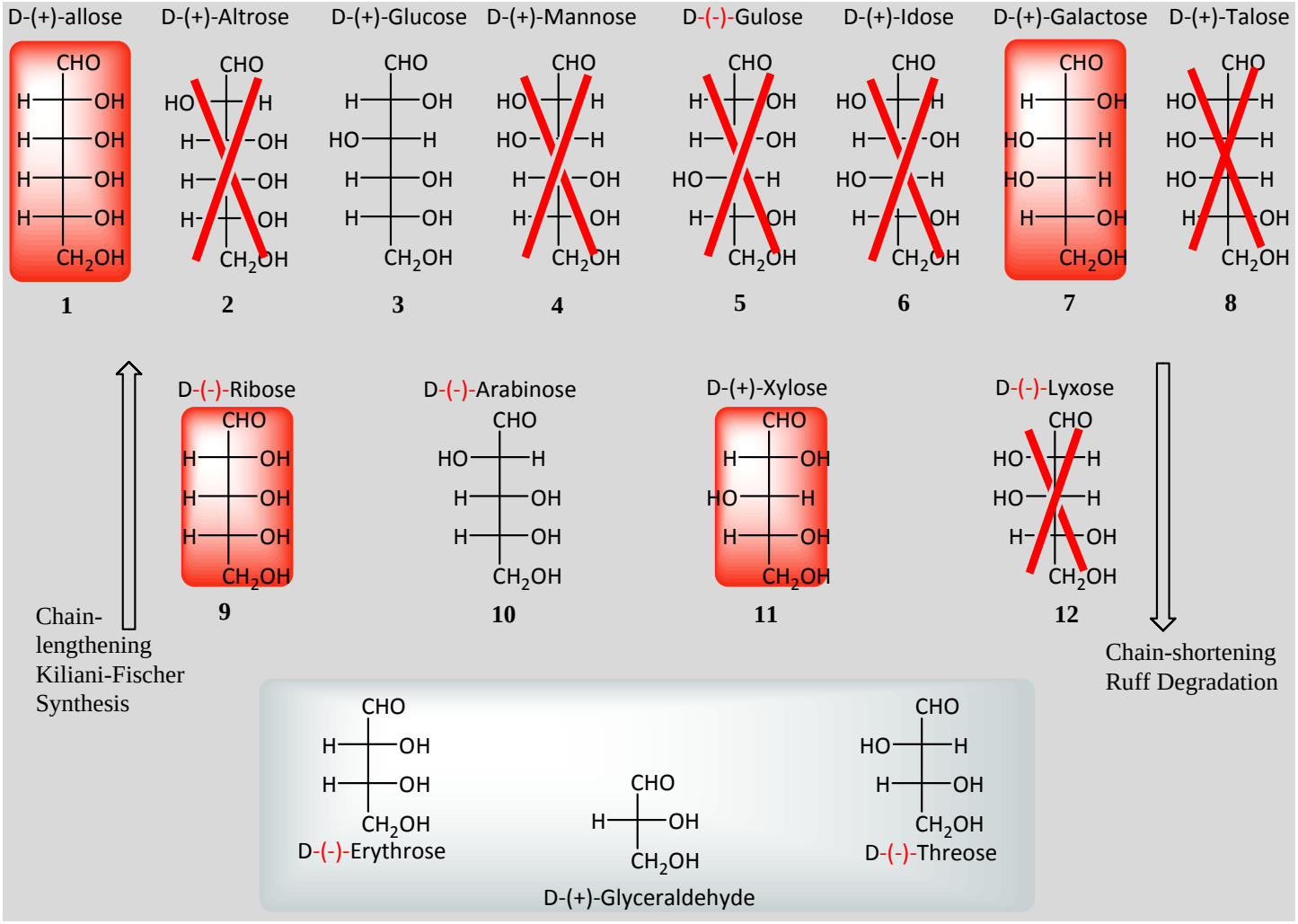
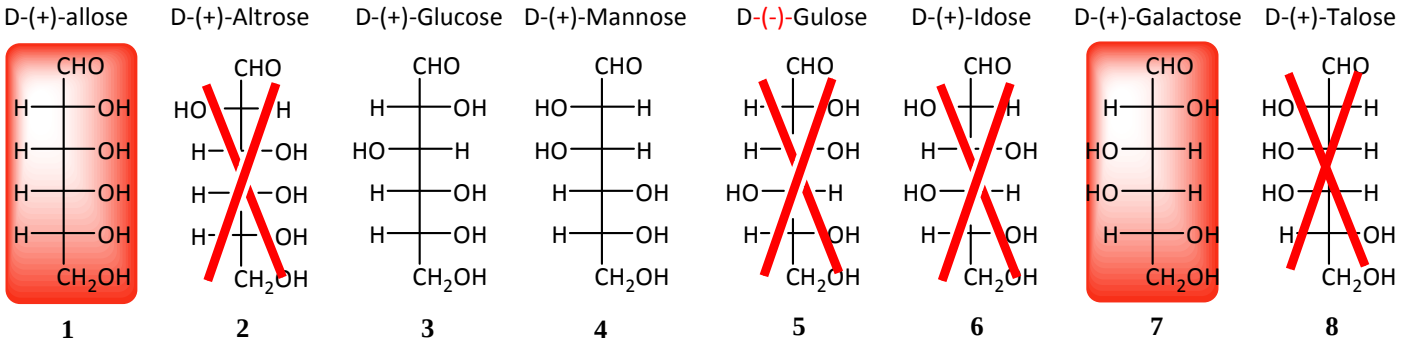
Fischer Proof of the Structure of D-(+)-Glucose



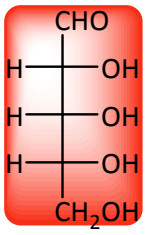
1. Nitric acid oxidation of (+)-glucose gives optically active aldaric acid.

This eliminates structures 1 and 7, Allose and Galactose, which would give meso aldaric acids.



2. Degradation of glucose gives arabinose and oxidation of arabinose gives an optically active aldaric acid. This means arabinose must be structure 10 or 12 but cannot be structure 9 or 11. Therefore, 2, 5 and 6 are eliminated as well.

D-(-)-Ribose



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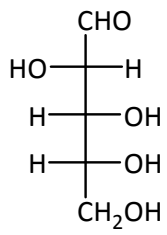
D-(-)-Arabinose



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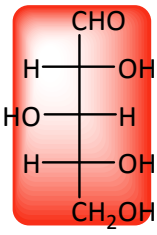
D-(+)-Xylose



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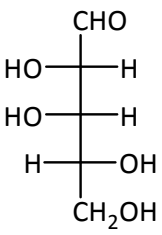
D-(-)-Lyxose



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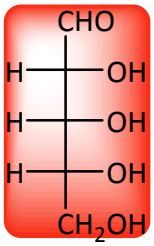
3. Chain lengthening of D-arabinose gives D-glucose and D-mannose; oxidation of both glucose and mannose gives optically active aldaric acids. This eliminates 12 as a possibility for arabinose because chain-lengthening of 12 followed by oxidation would give one inactive aldaric acid (from 7). Therefore, 8 is eliminated as well.

D-(-)-Ribose



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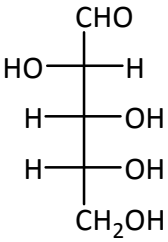
D-(-)-Arabinose



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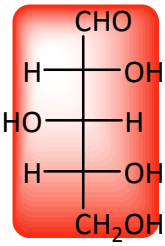
D-(+)-Xylose



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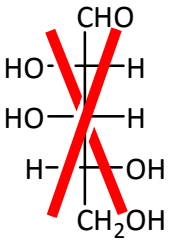
D-(-)-Lyxose



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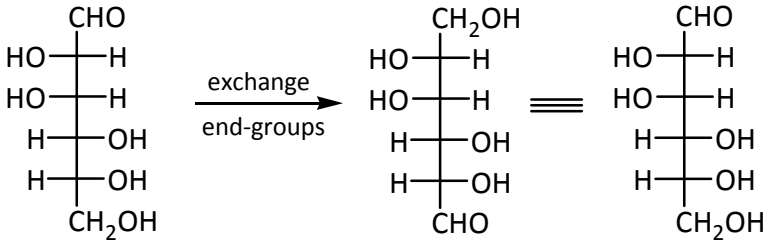
4. Only glucose and mannose remain and they must be C2 epimers.

5. By a series of reactions, the the two ends of glucose (the aldehyde and primary alcohol) could be exchanged and would not give the same aldose, structure 4. On the other hand, exchange of end groups on mannose would give the same aldose.

End-group exchange on structure 4 gives same aldose:



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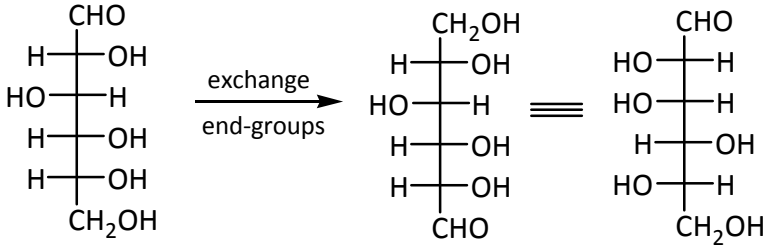
End-group exchange on structure 3 gives different aldose; it gives L-gulose.



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L-gulose