# White’s Medium

## White’s Medium in Plant Tissue Culture: Origins, Uses, and Formulation

**Origin:**

White’s medium, a cornerstone in plant tissue culture, wasn’t developed as a single, unified formulation but rather evolved from the pioneering work of Philip R. White in the 1930s and 1940s. White, a prominent figure in plant tissue culture, wasn’t aiming to create a universally applicable medium. Instead, his research focused on developing defined nutrient solutions for growing plant tissues *in vitro*, a groundbreaking approach at the time. His numerous publications detail various modifications and refinements of his initial formulations, resulting in several "White’s media," each optimized for specific plant species or applications. There’s no single "year" of its creation, but the foundational work that led to its widespread use solidified over this period, building upon earlier studies by Knudson and others on orchid nutrient requirements. The initial goal was to achieve sustained growth of plant tissues under sterile conditions, a significant challenge at that time. This involved painstaking experimentation to identify essential nutrients and growth factors.

**Applications:**

White’s medium, in its various adapted forms, found early applications in propagating a range of plant species,

particularly those recalcitrant to conventional propagation methods. It's particularly well-suited for woody plants, where it has shown success in callus induction, shoot multiplication, and root formation. Several orchid species, known for their challenges in propagation, have also responded well to White's medium. Though not as widely used for all applications as Murashige and Skoog (MS) medium, which later became more dominant, White's medium remains relevant in specific niches. Successful applications include:

- **Callus induction:** Generating undifferentiated masses of cells from explants (plant tissues).
- **Organogenesis:** Inducing the formation of shoots and roots from callus tissue, enabling clonal propagation.
- **Embryogenesis:** In some cases, it supports somatic embryogenesis, which is the development of embryos from somatic cells.
- **Rooting:** It successfully promotes root development in micropropagated shoots and cuttings of various plants.

Notable studies using White's medium have focused on the regeneration of forest trees and the propagation of commercially valuable orchids, demonstrating its effectiveness in recalcitrant species.

**Formulation:**

The formulation of White's medium varies slightly depending on the specific publication and adaptation. However, a common representative formulation (concentrations may vary slightly depending on source) is shown below. It's crucial to note that the success depends heavily on adjusting the plant growth

regulators (PGRs) based on the specific plant species and the desired outcome (shoot or root induction).

| Component | Concentration (mg/L) | Role |
|---|---|---|
| $NH_4NO_3$ | 1650 | Nitrogen source |
| $KNO_3$ | 1900 | Nitrogen and potassium source |
| $CaCl_2 \cdot 2H_2O$ | 440 | Calcium source |
| $MgSO_4 \cdot 7H_2O$ | 370 | Magnesium and sulfate source |
| $KH_2PO_4$ | 170 | Phosphorus source |
| $FeSO_4 \cdot 7H_2O$ | 27.8 | Iron source |
| $MnSO_4 \cdot H_2O$ | 2.2 | Manganese source |
| $ZnSO_4 \cdot 7H_2O$ | 0.22 | Zinc source |
| $H_3BO_3$ | 6.2 | Boron source |
| KI | 0.83 | Iodine source |
| $Na_2MoO_4 \cdot 2H_2O$ | 0.25 | Molybdenum source |
| $CuSO_4 \cdot 5H_2O$ | 0.025 | Copper source |
| $CoCl_2 \cdot 6H_2O$ | 0.025 | Cobalt source |
| Thiamine HCl | 1 | Vitamin B1 |
| Nicotinic acid | 1 | Vitamin B3 |
| Pyridoxine HCl | 1 | Vitamin B6 |
| Myo-inositol | 100 | Osmolyte and precursor for other metabolites |
| Sucrose | 20-40 g/L | Carbon source |
| Agar | 6-8 g/L | Solidifying agent |

**Growth Regulators:** These are *not* included in the above table because their concentration and type (auxins like IBA, NAA, 2,4-D; cytokinins like kinetin, BA; gibberellins) vary

dramatically and are crucial for directing the culture towards the desired morphology (shoot proliferation, root formation, embryogenesis, etc.)

**Conclusion:**

White’s medium represents a significant contribution to the early development of plant tissue culture. While its formulation is simpler than some modern alternatives, its strengths lie in its effectiveness with specific plant groups, particularly woody plants. Its relative simplicity can make it cost-effective in some situations. However, limitations include potentially lower stability of auxin compared to MS medium, and it might not be suitable for all plant species or every application. Compared to MS medium, which offers broader applicability and potentially more robust growth for many species, White’s medium remains a valuable tool in specific areas where its unique properties prove more advantageous. While MS and B5 media have largely surpassed White’s in popularity for general use, it continues to find application in particular niche areas, highlighting its enduring contribution to plant biotechnology.