# Tulecke’s Medium (Ginkgo)

## Tulecke’s Medium (Ginkgo) in Plant Tissue Culture: Origins, Uses, and Formulation

Tulecke’s medium, often referred to as Ginkgo medium, holds a significant place in the history of plant tissue culture, particularly for its success with recalcitrant woody species. While not as ubiquitously used as Murashige and Skoog (MS) medium, it remains a valuable tool for specific applications.

**Origin:**

Developed by W.E. Tulecke in the late 1960s, the original formulation aimed to improve the propagation and regeneration of *Ginkgo biloba*, a notoriously challenging species for in vitro culture. The medium’s successful application to this ancient tree laid the groundwork for its later adaptations to other woody plants. While the exact year of its initial publication is debated, its prominence arose around the late 1960’s and early 1970’s through various publications and presentations by Tulecke and colleagues addressing difficult-to-culture species. The creation stemmed from a need to overcome several hurdles in propagating ginkgoes, including difficulties in inducing callus formation and shoot regeneration from various explants.

**Applications:**

Tulecke’s medium excels in inducing callus formation, shoot proliferation, and root development in several plant species,

especially woody gymnosperms and some angiosperms. Its strength lies in its ability to handle difficult-to-culture plants that often fail to respond to more widely used media like MS or B5. It’s been successfully used for:

- **Callus induction:** From various explants like cotyledons, hypocotyls, and nodal segments.
- **Organogenesis:** Efficient shoot and root formation, vital for micropropagation and plant regeneration from cuttings or other tissues.
- **Somatic embryogenesis:** Although less frequently reported than organogenesis, some studies indicate success in inducing somatic embryogenesis in certain plant species using modified Tulecke’s medium.

Notable successes include improved micropropagation protocols for various conifer species and certain fruit trees. While specific large-scale commercial applications are less common compared to MS medium, the medium’s unique suitability for recalcitrant plant species means it still holds relevance for research and specialized applications.

**Formulation:**

The exact formulation of Tulecke’s medium can vary slightly depending on the specific application and plant species. The following table provides a representative composition, but researchers often adjust hormone concentrations to optimize results. Note that nutrient concentrations are typically expressed in mg/L.

| 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 sulfur 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 |
| $ZnSO_4 \cdot 7H_2O$ | 0.84 | Zinc source |
| KI | 0.83 | Iodine source |
| $H_3BO_3$ | 6.2 | Boron 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 |
| Pyridoxine HCl | 1 | Vitamin B6 |
| Nicotinic acid | 1 | Vitamin B3 |
| Myo-inositol | 100 | Growth factor |
| Sucrose | 30000 | Carbon source |
| Agar | 6-8 g/L | Solidifying agent |
| Growth Regulators | Variable | Auxins (e.g., NAA, 2,4-D), Cytokinins (e.g., BAP, Kin) |

**Common Modifications:** The most frequent modifications involve adjusting the concentrations of auxins and cytokinins to manipulate callus induction, shoot proliferation, and root formation. Researchers often experiment with different

combinations and ratios to optimize the process for a particular plant species or tissue type.

**Conclusion:**

Tulecke’s medium offers a valuable alternative to more widely used media like MS or B5, particularly for recalcitrant species. Its strengths lie in its effectiveness in inducing callus formation and subsequent organogenesis in woody plants where other media may fail. Limitations include the potentially less robust growth compared to MS in some species, and requiring optimization through careful adjustment of growth regulator concentrations for each plant species and application. Compared to MS, which is known for its broad applicability, Tulecke’s medium displays a more specialized utility, excelling where other formulations struggle. While MS remains a workhorse in plant tissue culture, Tulecke’s medium retains its importance within specialized research focusing on recalcitrant woody species and other plants requiring tailored nutrient conditions. Its relevance in modern plant biotechnology remains focused in specific niche areas where its unique formulation proves essential.