Schenk and Hildebrandt (SH) Medium

Schenk and Hildebrandt (SH) Medium in Plant Tissue Culture: Origins, Uses, and Formulation

Origin:

The Schenk and Hildebrandt (SH) medium, a cornerstone in plant tissue culture, was developed in the 1960s by Russell K. Schenk and Carol A. Hildebrandt at the University of Wisconsin-Madison. Their work, published in a series of influential papers, aimed to improve upon existing media formulations, particularly for the propagation of woody plant species which were notoriously challenging to cultivate *in vitro*. Prior media often lacked sufficient nutrients or suitable growth regulators for the successful propagation of these recalcitrant species. The SH medium represented a significant advancement, offering a more refined and effective approach to overcoming the limitations of earlier formulations. The original purpose was to establish a broadly applicable medium capable of supporting rapid growth and differentiation in a wider range of plant species than previously possible.

Applications:

SH medium finds broad application in various plant tissue culture techniques. Its primary uses include:

- **Callus induction:** The nutritional balance of SH medium makes it suitable for initiating callus formation from explants (small tissue samples) of many plant species. This is crucial for genetic transformation and other genetic manipulation techniques.
- **Organogenesis:** SH medium supports the development of shoots and roots from callus tissue, allowing for the creation of entire plantlets *in vitro*. This is vital for micropropagation, a technique used for mass-producing genetically identical plants.
- **Embryogenesis:** While less commonly used than MS medium for this specific application, SH medium has been successfully used to induce somatic embryogenesis (embryo development from somatic cells) in some plant species.
- **Rooting:** The medium facilitates root formation from shoots or plantlets, allowing for the successful transfer of plantlets from *in vitro* conditions to soil. Appropriate hormone adjustments (discussed below) are crucial for this application.

SH medium is particularly well-suited for woody plants, orchids, and certain horticultural crops. However, its efficacy varies depending on the specific plant species and the desired outcome. Several successful case studies demonstrate its effectiveness, with reports of enhanced shoot multiplication rates in various ornamental and economically important plants. For instance, research has shown high success rates in micropropagating several fruit tree species using modified SH medium.

Formulation:

The exact composition of SH medium can vary slightly depending on the source and the specific application. However, a typical formulation includes the components listed below. Note that concentrations are often reported as mg/L for macronutrients and micronutrients and µM for vitamins. Adjustments are commonly made to the concentrations of plant growth regulators, especially auxins and cytokinins, to optimize the process (e.g., callus induction versus shoot proliferation).

Component	Concentration (mg/L or µM)	Role
Macronutrients:		
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 and potassium source
Micronutrients:		
$FeSO_4 \cdot 7H_2O$	27.8	Iron source
$MnSO_4 \cdot 4H_2O$	22.3	Manganese source
$ZnSO_4 \cdot 7H_2O$	8.6	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
Vitamins:		
Thiamine HCl	10 (µM)	Vitamin B1
Nicotinic acid	5 (µM)	Vitamin B3

Component	Concentration (mg/L or µM)	Role
Pyridoxine HCl	5 (µM)	Vitamin B6
Growth Regulators:		
Auxins (e.g., NAA, 2,4-D)	Variable	Root formation, callus induction
Cytokinins (e.g., BAP, Kin)	Variable	Shoot proliferation, callus formation
Sucrose	30000	Carbon source
Agar	8000	Gelling agent

Conclusion:

SH medium remains a valuable tool in plant tissue culture, boasting strengths such as its effectiveness with recalcitrant species and a relatively simple formulation. However, limitations include the potential for instability of certain growth regulators and its possibly less consistent efficacy compared to more widely used MS medium in some applications. The choice of medium often depends on the specific plant species, the intended outcome, and cost considerations. While MS medium has arguably surpassed SH in popularity and versatility for many applications, SH continues to be relevant, especially in research focusing on woody plants and specific horticultural species. Modifications to the basic SH formulation, primarily tailored hormone concentrations and the inclusion of other supplements like activated charcoal, often optimize its performance for specific objectives. Ultimately, careful selection of medium and its associated modifications remains crucial for successful plant tissue culture experiments.