Lloyd and McCown BA Medium

Lloyd and McCown BA Medium in Plant Tissue Culture: Origins, Uses, and Formulation

Origin:

The widely used Lloyd and McCown Woody Plant Medium, often abbreviated as BA medium, owes its existence to George Lloyd and Bruce McCown. Developed in the early 1980s at the University of Wisconsin-Madison, this medium wasn't born from a single, sweeping innovation, but rather from a concerted effort to improve in vitro propagation techniques for woody plants – a notoriously challenging group for tissue culture. Prior media, often adaptations of Murashige and Skoog (MS) medium, frequently failed to produce satisfactory results with recalcitrant woody species. Lloyd and McCown's focus was on creating a nutrient formulation specifically tailored to overcome the limitations experienced with these plants, ultimately leading to significantly enhanced shoot multiplication and rooting rates. Their original purpose was to simplify and improve the micropropagation of economically important fruit trees and forest trees, species known for their difficulty in responding to conventional tissue culture approaches.

Applications:

BA medium found immediate success and has since become a staple in plant tissue culture laboratories worldwide. It's particularly renowned for its efficacy in propagating woody

plants, including many fruit species (apples, pears, cherries), ornamentals (roses, rhododendrons), and forest trees (conifers, hardwoods). However, its applications extend beyond woody plants; it has also shown success in herbaceous species with some modifications.

The medium excels in several key tissue culture applications:

- **Shoot Multiplication:** BA medium's balanced nutrient composition and often-included cytokinins promote the rapid formation of multiple shoots from explants (small pieces of plant tissue), greatly enhancing propagation efficiency.
- **Organogenesis:** It supports both shoot and root organogenesis, enabling the generation of complete plantlets directly from callus or other explants. The precise hormonal balance is critical in this, influencing the pathway taken.
- **Rooting:** The modified formulations often containing auxins in lower concentrations, facilitate efficient root development from shoots produced on the medium.
- **Germplasm Conservation:** It's valuable for long-term storage of plant material due to its ability to maintain plant material in a healthy, actively growing state in vitro.

Several studies have highlighted the superiority of BA medium to other media in specific species. For example, its effectiveness in micropropagating difficult-to-culture apple cultivars has been extensively documented. Success with other challenging species, like orchids, has also been observed through modifications of the standard BA medium recipe.

Formulation:

The core formulation of BA medium (concentrations can vary slightly between laboratories and applications) is shown below. Modifications are common, particularly by adjusting the concentrations of growth regulators (auxins and cytokinins) which are key parameters for influencing specific responses (e.g., shoot proliferation vs. rooting). Note: Many formulations use the nutrient stock solutions from Murashige and Skoog (MS) medium.

Component	Concentration (mg/L)	Role
Macro-nutrients		
NH_4NO_3	1650	Nitrogen source
KNO_3	1900	Nitrogen & Potassium source
$CaCl_2$	440	Calcium source
$MgSO_4 \cdot 7H_2O$	370	Magnesium & Sulfate source
KH_2PO_4	170	Phosphorus & Potassium source
Micro-nutrients		
KI	0.83	Iodine source
$MnSO_4 \cdot H_2O$	22.3	Manganese source
$ZnSO_4 \cdot 7H_2O$	8.6	Zinc 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
$FeSO_4 \cdot 7H_2O$	27.8	Iron source (often in chelated form)

Component	Concentration (mg/L)	Role
Na-EDTA	37.3	Iron chelator
Vitamins		
Thiamine HCl	1.0	Vitamin B1
Pyridoxine HCl	0.5	Vitamin B6
Nicotinic Acid	0.5	Vitamin B3
Myo-inositol	100	Osmoprotectant, growth regulator
Growth Regulators	(Variable; depends on application)	
Sucrose	30,000	Carbon source
Agar	8,000	Solidifying agent

Conclusion:

BA medium represents a significant advancement in plant tissue culture, particularly for woody plant species. Its strengths lie in its relatively simple formulation, high efficiency in shoot proliferation and rooting, and its relative cost-effectiveness compared to some other specialized media. However, limitations exist. The optimal hormonal balance requires careful experimentation for each specific plant genotype and application. Additionally, the stability of some growth regulators in the medium over time can be a concern.

Compared to MS medium, BA is often considered more efficient for woody plants, whilst MS is more versatile and widely used across many plant species. B5 medium, another popular choice, holds similar versatility to MS but may exhibit differing hormone response patterns. The choice of medium ultimately depends on the target species, the desired outcome (e.g., shoot multiplication, root induction), and the researcher’s

experience. Despite the emergence of newer formulations, BA medium retains its relevance in modern plant biotechnology, especially for woody plant propagation and germplasm conservation purposes. Its continued use and modification make it a testament to its enduring influence on plant tissue culture methodology.