salk
Where cures begin.

BrainPhys™: A Novel Medium for Functional Neuronal Cultures

INVENTION: Salk investigators have designed and tested a tissue culture basal neuromedium with supplements that effectively supports neuronal activity. The improvements made in this medium reduce the gap between *in vivo* brain physiological conditions and neuronal models *in vitro*. The Salk neuromedium radically improves and sustains healthy neuronal and synaptic activity of long-term neuronal cultures (rodent and human), and allows optimal electrophysiological recordings without the need to move the cells to a different medium inadequate for tissue culture.

APPLICATIONS:

- Long-term/short-term culture of mature and active human or rodent neurons
- Assessment of electrophysiological functions with patch-clamping, calcium imaging and multielectrode arrays (MEAs)
- Maintenance *in vitro* of neurons obtained from induced pluripotent stem cells (iPSCs), embryonic stem cells (ESCs), induced neurons (iNs), primary neurons, organotypic slices and brain slices.

ADVANTAGES:

Table 1. Properties of various basal neuromedia

		DMEM	Neurobasal	ACSF	BrainPhys
Cell culture (basal Neuromedium+ supplements)	Neuronal survival in vitro	✓	✓	Less than few days	✓
	Neuronal differentiation in vitro	✓	✓	X	✓
Neuronal activity and fundamental neuronal functions	Spontaneous and evoked action potentials	Impaired	Impaired	✓	✓
	Network spontaneous calcium activity	Impaired	—	✓	✓
	Excitatory synaptic activity	Blocked	Low	✓	✓
	Inhibitory synaptic activity	Blocked	Blocked	✓	✓
	Neuronal function in vitro	Not physiological	Not physiological	✓ Short-term only	✓ Physiological
Neurophysiological properties of the media	Inorganic salt	✓	Not physiological	✓	✓
	"Neuroactive" components	Saturating neural activity	Saturating neural activity	✓	✓
	Glucose level	Hyperglycemic	Hyperglycemic	Hyperglycemic	✓Physiological
	Osmolarity (mOsmol)	✓ (315)	Low (220-250)	✓ (~300)	✓ (305)
	pH	✓ (7.4)	✓ (7.4)	✓ (7.4)	✓ (7.4)

We identified unphysiological properties in widely used basal media and resolved them in a new neuronal medium (BrainPhys).

- Mimics human brain physiological conditions to improve the relevance of in vitro models
- Eliminates the need to use different media for culture and electrophysiological assessments
- Chemically defined and serum-free
- The basal medium can be easily customized with the addition of various supplements
- Provide efficient and physiological conditions for neuronal differentiation
- Promotes active synaptic communication
- Sustains optimal electrophysiological neuronal activity

BACKGROUND: Neuronal cultures are very valuable when investigating basic principles of the nervous system, and therefore are widely used by the research community. *In vivo,* neural electrical activity is the essence of nervous system function, controlling emotion, memory, sensory modalities and behavior. Salk investigators have discovered that many crucial neurophysiological properties are altered in classic culture media that are widely used by the research community. To overcome this problem, they designed and tested a new neuromedium that adequately supports *in vitro* neuronal activity. The improvements made in this medium make neuronal models *in vitro* more physiological and therefore more relevant to medical research. Improving physiological conditions *in vitro* may lead to more successful translation from bench to clinics.

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