

**Review Article**

# Of Scents and Brain: Olfactory Stimulation for Neuropoiesis and Intervention for Neurodegenerative Disorders

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## Abstract

Aromatherapy is an ancient scent treatment that has gained a lot of attention in the contemporary research for its various benefits. The role of olfactory stimulation leading to neuropoiesis has been a major consideration for treating neurodegenerative disorders like dementia, Alzheimer's and Parkinson's as well as psychiatric symptoms like mood disturbances, anxiety and sleep problems. The literature review has concentrated on the significance of the olfaction in the mammalian physiology and enlightened the hypothesis with noteworthy evidences to support the idea that with more research and clinical trials aromatherapy can attest to be a major breakthrough in treating Alzheimer's disease and reversing neurodegeneration.

## Keywords

Aromatherapy, Neuropoiesis, Alzheimer's, Dementia, Neuro-degeneration

## Aromatherapy

Aromatherapy is one of the simplest and natural approaches used for healing. Literally, it is a derivative of two different words: aroma meaning fragrance, smell or scent and therapy meaning remedy, cure or treatment (University of Maryland Medical Center, 2013). It is a blend of biological and manipulative techniques that uses the fragrances or scented oils usually with massage, acupuncture or any other suitable treatment (British Columbia, 2012). Thus, healing process involves the combination of two senses: touch and smell. The treatment is presumed to be helpful in supporting and balancing the mind, body and soul where each fragrance has a distinct effect on the nervous system and body. The practice involves the topical application, infusion in bath water, inhalation, and ingestion under strict supervision only. Yet, the manner of therapy is chosen according to the need of the consumer and requirement of the target. It is because each application has its own mode of action. For example, the inhalation of scents activates the limbic system while the topical application stimulates the thermal receptors of the dermis (Nordqvist, 2014 and Demetriou 2000).

## Research in Aromatherapy

Clinical studies have showed that fragrances treatment provides relaxation from anxiety, stress, depression, cancer related symptoms, agitation in dementia, pain and quality of sleep (Najafi, et al, 2014, Williams, 2006, Holmes, et al, 2002, Ballard, et al, 2002, Fayazi, et al, 2011 and Diego, 1998).

Aromatic therapy relieves both the mental and physical stress and has a tendency of enhancing the parasympathetic nervous system and autonomic nervous system (Liu, et al, 2014, Glass, et al, 2013 and Chang K.M, et al, 2011).

## Senses; Smells and Behaviors

Out of five senses, the aromatherapy engages two, touch and smell, for bringing upon the effects. These two senses are believed to have an emotional connection. For instance, the most sacred relationship of a Mother and her child bonds by these exceptionally strong senses (Demetriou, 2000). Studies show that babies tend to be finely sensitive towards the touch and scent of their biological mothers. These interactions bring physiological and psychological serenity to the babies and improve their growth and health (Agneta, 2014, Elizabeth et al, 2012, Delaunay-El, et al, 2010 and Doucet, et al, 2007). Baby's response to mother's touch positively elevates when is accompanied with the odor (Durand K, 2013).

The olfaction has an extraordinary significance in various physiological processes and psychological perceptions. For example, pheromones are the chemical substances secreted by the body of an animal that unlike all hormones, produce alterations in the physiology of other animals and not on one's own body (Mostafaa, et al, 2012 and Tirindeli R, et al, 2009). Pheromones provide individuals with their characteristic odor which allows baby to identify their mother and a person to distinguish their partner



from others (Lundstorm, et al, 2013 and 2008 and Sobel N, et al, 2001).

Mammals have a distinct region in their olfactory system that senses the odors from pheromones and recognize them. The region is known as Vomeronasal Organ (Ogura, et al, 2010 and Tirindeli, et al, 2009) or Jacobson's Organ (Moran, et al, 1991), and is located in the nose (Brennan, et al, 2006). The neuronal cells of this organ synapses with the Amygdala and then Hypothalamus (Nordqvist, 2014). Olfaction of pheromones chiefly determines the physiology that fortifies the survival and is required for the determination of the sexual preferences, mating behavior, reproduction cycle, hormonal secretions, alertness, defensive nature, social behavior and territory mark (Woodley, et al, 2015; Dibattista, et al, 2012; Ogura, et al, 2010; Salazar, et al, 2009; Richard, et al, 2009; Snowdown, et al, 2006 and McClintock, 1998). Even though scents have similar effects on humans but it only plays a small role. It is because homosapiens have more developed and complex nervous system and evaluate situations and preferences with higher level of cognition (Mostafaa, et al, 2012).

Furthermore, pheromones have a very unusual function in some mammals like scientists have observed that when a pregnant mouse shares the vicinity with an unfamiliar male mouse, the pregnancy gets terminated naturally. This phenomenon is called the Bruce Effect and mainly involves the olfaction. The pregnant female senses the odor of a strange mouse, as the male secretes the pheromones. The scent influences the pregnancy in a way that it dampens the prolactin secretion in the female body. Prolactin is a precursor for progesterone and thus, the production of this hormone inhibits and as progesterone supports the gestation, the reduction causes the abortion. The nature is said to be adaptive because when new male animals take the dominancy, they do not father the unrelated baby, and rather they kill those newborns and mate with the females to give rise to their own bloodline. This adaptation saves the female from undergoing the stress of pregnancy and delivery, as the child would have no chances of living (Rajendren, et al, 1987, Yong, 2012 and Science Whiskers, 2012).

### **Scents and Brain**

The sense of smell is found to be 10,000 times stronger than the other senses. A stimulus from sensing a fragrance travels more quickly towards the brain than others. It is estimated that our nose can

sense 10,000 different scents distinctively (Nordqvist, 2014 and Damian, 1995). The stimulus of an odor is taken from the nasal reception to brain, where it stimulates the Amygdala and Hippocampus (Jorge, et al, 2014) in the Limbic System (Halcon, 2013). If the functions of these brain areas are summarized then it can be stated that amygdala holds the responsibility of generating an appropriate behavioral response while hippocampus determines the behavioral patterns and stores the memories (Guyton, 2010). Primarily, the reward and punishment centers are located in this region while hypothalamus is also responsible for the regulation of arterial pressures, heart rate, body temperature, thirst, water reabsorption from kidneys, uterine contractility, milk ejection, hunger, feeding reflexes and hormonal secretion from the anterior pituitary (Guyton, 2010). Thus, the fragrances can cause the alterations in body's physiological processes. The evidence of promising relationship between the hypothalamus, endocrine system and olfaction is the Kallmann Syndrome.

Kallmann syndrome is an X-linked genetic disorder which is characterized by the lack of olfactory perception and a delay in puberty. The mutated gene causes anomaly in the migration of olfactory receptor cells and gonadotropin releasing cells that disturbs the hypothalamus-pituitary axis that ultimately delays the puberty. Thus any defect in the olfactory bulb interrupts the communication between the hypothalamus and anterior pituitary gland (Lutz, et al, 1993 and Rugarli, et al, 1993).

It is also reported that scents have an ability to bring upon emotional changes in an individual depending on the consumer's perception and memory. This is called the Proust Effect, where a scent can evoke certain memories (Chen, 2013, Campen, 2013 and Hamilton, 2012).

### **Olfactory System**

Evolutionary studies have confirmed that olfactory system is the oldest system that perceives the sensations in the mammalian body and has an ability to regenerate (Purves, 2001). The Olfactory Ensheathing Cells or OECs in the olfactory bulb provides the fascicles for the repair and regrowth of the mature olfactory neuronal cells. Scientists have been successful in utilizing regenerative properties of these cells by implanting them into the sites of spinal damage and successfully treating the lower body paralysis (BBC News, 2014).

The olfactory system has a prominence in all the sensory processes due to various reasons which may

include the sensitivity, association with memory and behavior, harmony with endocrine functions and a reputation of being the oldest. Nonetheless, amongst all these the one peculiar aspect is that the olfactory sensations reach the cerebral cortex directly (Li, et al, 2007), without relaying information through the thalamus (Guyton, 2011). The electro-olfactogram further activates the nerves of the nervous system along the olfactory tract. The significance of olfactory nerve activation is its ability of potentiating the power of incoming stimulation. Hence, our nose holds a remarkable sensitivity even towards a small concentration of odor (Tortora, 2010).

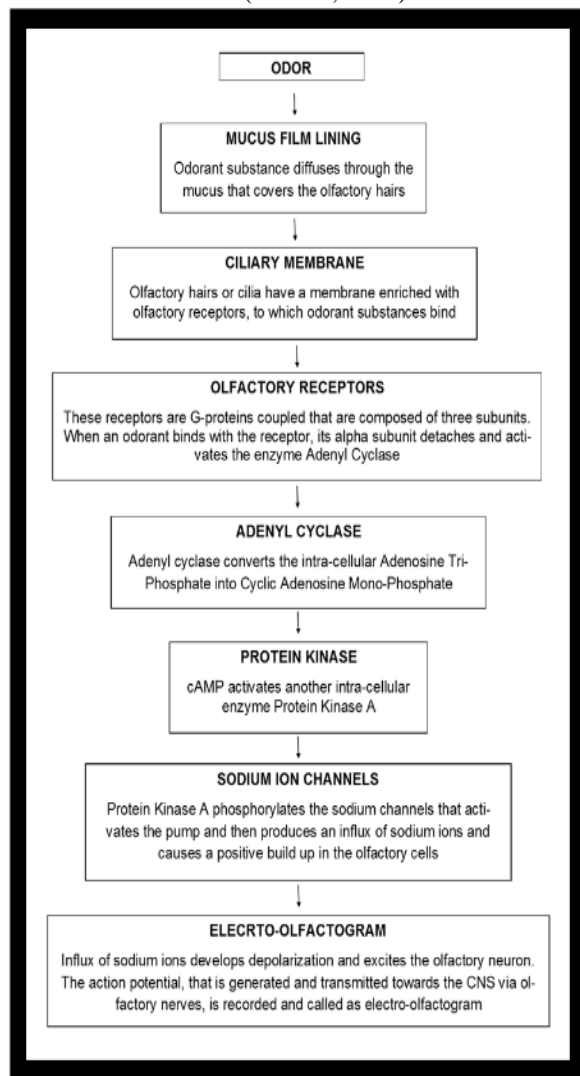


Figure: Stimulation of Olfactory Cells by the Odor and Activation of Electro-Olfactogram. (Adapted from Chen, et al, 2012, Guyton, 12th edition, Moran, 2007, Knecht, et al, 2004, Scott, et al, 2002 and Furukawa, et al, 1989).

## Conclusion

Aromatherapy has gain a lot of attention in contemporary research for treating neurodegenerative conditions like dementia and psychiatric symptoms like anxiety, sleep problems and mood disturbances (Perry, et al, 2006). Although the neurophysiological, biochemical and pharmacological basis of the aromatic treatments are not well-recorded yet researchers are still working dedicatedly on the clinical trials to establish a ground for the efficacy of the techniques involving the scent therapies.

The aromatic treatment has been recently observed to have some influence on deteriorating cognitive functions and thus attained a status of interest in the domain of Alzheimer's disease. Anosmia, the loss of sense of smell, is often developed along with dementia in the AD because of the gradual neurodegeneration and development of neurofibrillary tangles and plaques. Neuroscientists have stated the fact that neurons in the olfactory bulb can undergo regeneration throughout the life. With regard to this observation, it is hypothesized that the olfactory excitation provided by the aromatherapy can help in stimulating the neurogenesis in the olfactory bulb. As olfactory region tends to be directly in communication with the hippocampus and limbic system, it is believed that the neuronal regeneration reaches these regions and initiates neurogenesis that ultimately improves the cognition and prevents further deterioration and memory loss (Jimbo, et al, 2009).

Working on these aspects with clinical trials and molecular studies can be a major breakthrough in treating Alzheimer's disease and other neurodegenerative conditions like dementia and Parkinson's. It is not though possible to utilize the benefits of aromatherapy without noting down the general effects and thus reliable evidence is required to include these therapies to the clinical practices. Therefore, thorough research is needed in future where these interventions can help with mental health issues and more studies involving physiological and biochemical analysis for learning the association between hormonal and neurotransmitters must also be performed.

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