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Unravelling the Environment, Aroma, and Molecular Effects on Mood Fluctuations: A Review

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Abstract

The ebb and flow of human emotions encompass a complex interplay of molecular processes governing mood fluctuations. This comprehensive review navigates the intricate realm of neurotransmitters, neuroplasticity, hormonal influences, genetics, and inflammation to unravel the molecular tapestry that shapes our emotional states. Foundational to mood regulation are neurotransmitters – serotonin, dopamine, and norepinephrine – orchestrating delicate balances within neural circuits. Recent molecular neuroscience elucidates their receptor pathways and signaling cascades, offering insights into how genetic predispositions and environmental factors impact mood disorders. This review dissects synaptic signaling mechanisms and neurotransmitter modulation, illuminating the intricate molecular basis of mood. Neuroplasticity, the brain's adaptive prowess, emerges as a pivotal player in mood regulation. Molecular intricacies underlying synaptic plasticity and neural adaptation reveal the shaping of emotional landscapes over time. This exploration underscores the dynamic molecular foundation of resilience and vulnerability to mood fluctuations. The hormonal symphony orchestrated by the endocrine system, especially the hypothalamic-pituitary-adrenal (HPA) axis, significantly influences mood. Molecular insights into the crosstalk between hormonal and neurotransmitter systems unveil genomic and epigenetic mechanisms modulating mood-related brain circuits. Chronic stress-induced HPA axis dysregulation stands as a molecular contributor to mood disorders, spotlighting potential therapeutic avenues. Genetic landscapes intricately woven into mood disorders reflect a tapestry of multiple genes with varying impacts. Molecular genetics, encompassing genome-wide studies and epigenetic investigations, decode the complex interplay between genetic variations, gene expressions, and mood regulation. This understanding holds promise for personalized interventions. Inflammation emerges as a novel molecular player influencing mood regulation through immune-neural interactions. Molecular pathways linking immune activation to neurotransmitter alterations offer new perspectives on mood disorder aetiology, opening avenues for therapeutic interventions.

Keywords: Neurotransmitters, environmental, genetics, molecular. mood disorders, inflammation and mood regulation, chronic stress

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INTRODUCTION

The human emotional spectrum, woven with diverse shades of feelings, finds its essence in the intricate dance of mood fluctuations [1]. As we mark, this exploration delves into the molecular labyrinth shaping these emotional contours, aiming to decipher their fundamental complexities [2]. Understanding the molecular substrates of mood regulation is akin to deciphering a symphony orchestrated by billions of neural cells. Serotonin, dopamine, and norepinephrine emerge as pivotal molecular conductors orchestrating this intricate dance, delicately harmonizing emotional equilibrium [3]. The molecular intricacies of neurotransmitter actions, receptor interactions, and downstream pathways form the cornerstone of our expedition—a revealing chapter elucidating the neural mechanisms behind emotional highs and lows. Neuroplasticity unfolds as a captivating act in our narrative, spotlighting the brain's adaptive prowess [4]. The molecular intricacies guiding synaptic plasticity and neural adaptability illuminate how experiences sculpt emotional landscapes. Unravelling the molecular underpinnings of neuroplasticity unveils the brain's capacity to reconfigure its emotional responses over time, shaping individual emotional resilience. The hormonal ballet performed by the endocrine system, notably the HPA axis, commands attention in our exploration [5]. Molecular insights into the intricate hormonal dialogue with neurotransmitter systems unveil the genomic and epigenetic mechanisms shaping mood-related brain circuits. Dysregulation of the HPA axis, a molecular outcome of chronic stress, emerges as a significant contributor to mood disorders, offering avenues for targeted interventions. Genetic contributions entwined within mood disorders present a genomic tapestry woven with multiple threads of varying impacts [6]. Molecular genetic studies decode the intricate relationships between genetic variations, gene expressions, and mood regulation [7]. This genetic mosaic paves the way for tailored approaches to understanding and treating mood disorders [8]. Inflammation, a novel molecular contender in mood regulation, emerges from the crossroads of immune and neural systems [9]. Molecular pathways linking immune activation to alterations in neurotransmitter function provide fresh insights into the origins of mood fluctuations, paving the way for novel therapeutic strategies [10].

Despite the research constraints in this area, a substantial amount of evidence already points to the possibility that physical surroundings may have an impact on mental health outcomes. Heavy metals, solvents, and pesticides are among the most thoroughly researched types of toxicants, out of hundreds that are both natural and artificial that have been linked to psychological problems and human psychiatric diseases [11]. The impact of these agents on non-cognitive, psychological end points like personality, impulse control, emotion management, and mental disorder symptoms have been less researched. Early pieces of research in neuro-epidemiology frequently concluded that changes in personality, mood, and affect after toxicant exposures were caused by psychological reactions to the exposure – that is, unsettling ideas and beliefs about having been exposed – rather than by real, observable pathology [11]. Studies on the relationship between self-reported affective state, or the fundamental experience of feeling, emotion, or mood, and exposure to natural surroundings have also been conducted [12]. Short-term exposure to natural habitats was proven to reduce depressive mood in a recent comprehensive review and meta-analysis [13]. Lastly, it is critical to recognize that advances in technology have led to better evaluations of mental health and exposure to outdoors. In one study, for example, people ranging in age from 18 to 75 tracked their location, level of physical activity, and mood over the course of several days using smartphones fitted with ecological momentary assessment applications. The results showed positive correlations with feelings of happiness, relaxation, and restoration within ten minutes of being in natural outdoor settings [14].

Environmental and Molecular Factors Influencing Mood Fluctuations

Mood fluctuations arise from a dynamic combination of environmental influences and molecular processes. Gaining a deeper understanding of these factors can offer valuable insights into how mood disorders develop and how they can be managed.

ENVIRONMENTAL FACTORS

1. Weather and Seasonal Changes

- *Seasonal Affective Disorder (SAD):* Reduced exposure to sunlight during colder months can trigger depressive symptoms in some people [15].
- *Temperature and humidity:* Extremes in temperature and high humidity levels can lead to discomfort, irritability, and fatigue, all of which can affect mood [15].
- *Rain and cloudy weather:* Extended periods of overcast skies and rain can contribute to feelings of sadness or lethargy [15].

2. Urban Living Conditions
- *Noise pollution:* Constant noise, typical of urban areas, can induce stress and anxiety, leading to mood changes [16].
- *Overcrowding:* High population density may cause stress, impacting overall mood and mental health [16].
- *Housing quality:* Poor living conditions, such as inadequate ventilation or heating, can exacerbate stress and cause mood instability [16].

3. Environmental Pollution and Toxins
- *Air quality:* High levels of air pollution, like smog, can cause physical symptoms, such as headaches and fatigue, which may negatively influence mood [17].
- *Chemical exposure:* Regular contact with certain chemicals, often in industrial or occupational settings, can impact brain function and mood regulation [17].

4. Natural Disasters and Extreme Events
- *Floods, earthquakes, and hurricanes:* Experiencing or even anticipating natural disasters can lead to heightened anxiety, fear, and depression [18].
- *Climate change:* Ongoing environmental changes related to climate can contribute to long-term anxiety and mood instability [18].

5. Disruption of Circadian Rhythms
- *Light exposure:* Inconsistent or inadequate lighting, particularly exposure to artificial light at night, can interfere with sleep patterns and result in mood disturbances [19].
- *Shift work:* Work schedules that disrupt normal sleep cycles can cause significant mood swings and increase the risk of mood disorders [19].

6. Social and Cultural Influences
- *Community and social support:* A lack of strong community ties or social support networks can lead to feelings of isolation and depression [20].
- *Cultural pressures:* Societal expectations and cultural stressors, including discrimination, can significantly affect mood and mental health [20].

MOLECULAR FACTORS

1. Neurotransmitters
- *Serotonin:* Reduced levels of serotonin are associated with depression, anxiety, and mood swings [21].
- *Dopamine:* Imbalances in dopamine can lead to disorders, such as depression and bipolar disorder, affecting mood stability [21].
- *Norepinephrine:* Variations in norepinephrine levels can trigger anxiety and mood swings [21].
- *GABA (Gamma-Aminobutyric acid):* Reduced levels of GABA are associated with heightened anxiety, depression, and mood instability [21].

2. Hormonal Influences
- *Cortisol:* Prolonged elevation of cortisol, a stress hormone, can result in increased anxiety, depression, and mood swings [22].
- *Estrogen and progesterone:* These hormones fluctuate during the menstrual cycle, pregnancy, and menopause, significantly impacting mood [23].
- *Thyroid hormones:* Dysregulation of thyroid hormones can contribute to mood disorders like depression or anxiety [24].

3. Neurotrophic Factors
- *Brain-derived neurotrophic factor (BDNF):* Reduced levels of BDNF are connected to depression and other mood disorders [25].

4. Inflammatory Markers
- *Cytokines:* Increased levels of pro-inflammatory cytokines like IL-6 and TNF-α have been linked to depression and mood swings. [26].
- *Microglia activation:* When microglia, the brain’s immune cells, are activated, they release inflammatory molecules that can disrupt mood regulation [26].

5. **Genetic and Epigenetic Factors**
   - *Genetic variants:* Certain genetic polymorphisms, such as those in the serotonin transporter gene (SERT), can increase susceptibility to mood disorders [27].
   - *Epigenetic changes:* Environmental factors and stress can change gene expression, which in turn can affect how mood is regulated [27].
6. **Endocannabinoid System**
   - *Endocannabinoids (Anandamide and 2-AG):* Imbalances in the endocannabinoid system can lead to anxiety, depression, and mood swings [28].
7. **Oxidative Stress**
   - *Reactive Oxygen Species (ROS):* An overproduction of ROS can lead to oxidative stress, causing neuronal damage and contributing to mood disorders [29].
   - *Antioxidant defence:* A compromised antioxidant defence system is linked to increased susceptibility to mood fluctuations [29].

AROMA FACTOR

1. **Direct Stimulation of the Limbic System**
   - *Amygdala and Hippocampus Activation:* Aromas can directly stimulate the amygdala and hippocampus, regions of the brain responsible for emotion and memory. This activation can evoke emotional responses and influence mood. For instance, pleasant smells like lavender or citrus are often associated with feelings of calmness and happiness, while unpleasant smells can trigger negative emotions, such as disgust or anxiety [30].
2. **Aromatherapy and Emotional Well-being**
   - *Lavender:* Widely used in aromatherapy, lavender is known for its calming effects, reducing stress, anxiety, and promoting relaxation. Research has found that the scent of lavender can lower cortisol levels, which helps improve mood and reduce anxiety [31].
   - *Citrus scents:* Citrus scents like lemon or orange are commonly used to boost mood and increase energy levels. These aromas are thought to reduce stress and improve cognitive performance, contributing to a more positive emotional state [32].
   - *Rosemary:* The scent of rosemary has been associated with heightened alertness and better cognitive function. It's frequently used to fight fatigue and boost mood by stimulating the brain [33].
3. **Associative Learning and Emotional Responses**
   - *Conditioned responses:* Smells are strongly linked to memories. A specific aroma can evoke memories that trigger corresponding emotions, thereby influencing mood. For example, the smell of freshly baked bread might evoke nostalgic feelings of comfort and warmth, leading to a positive shift in mood [34].
4. **Physiological Effects**
   - *Stress reduction:* Certain smells, such as vanilla or jasmine, have been found to lower heart rate and blood pressure, leading to a state of relaxation and a reduction in mood fluctuations associated with stress [35].
   - *Sleep and mood regulation:* Aromas like chamomile and sandalwood are known to promote better sleep. Improved sleep quality can significantly stabilize mood and reduce irritability, contributing to overall emotional well-being [36].
5. **Impact of Unpleasant Odours**
   - *Negative mood induction:* Just as pleasant smells can uplift mood; unpleasant odours can induce negative mood states. Exposure to foul smells can lead to feelings of disgust, irritability, and even nausea, contributing to mood fluctuations [37].

DISCUSSION

Our journey through the molecular landscape of mood fluctuations synthesizes insights across neurotransmitters, neuroplasticity, hormones, genetics, and inflammation, unveiling a comprehensive understanding of emotional dynamics [38]. This discussion interlaces key findings, explores their implications, and maps potential future trajectories within this evolving domain. The neurotransmitter symphony orchestrates emotional equilibrium, guiding therapeutic prospects targeting specific nodes in molecular pathways [39]. Exploring the implications of these molecular insights opens avenues for pharmacological interventions tailored to stabilize moods and bolster resilience [40]. Neuroplasticity stands as a cornerstone for mental health interventions, envisioning novel strategies leveraging the brain's inherent adaptability. Molecular insights into neuroplasticity pave the way for interventions, such as cognitive strategies and neurofeedback, harnessing the brain's rewiring abilities to foster positive emotional experiences [41]. Hormonal dialogues between endocrine and neural systems offer promising targets for interventions. Delving into interventions modulating molecular cascades triggered by chronic stress sheds light on potential therapeutic strategies to prevent or mitigate mood disorders [42]. Genetic landscapes unveiled through molecular genetics hold promise for personalized interventions [38]. Ethical considerations and the development of genetic counselling services are integral aspects of discussions centered on using genetic profiling for mental health treatments [43]. Inflammation's role in mood regulation prompts discussions on immune-targeted interventions as adjunct therapies [44]. However, the balance of immune modulation and potential risks necessitate cautious exploration [45]. Future directions entail integrating findings from neurotransmitters, neuroplasticity, hormones, genetics, and inflammation to gain a more comprehensive understanding of mood fluctuations [46]. Collaborative interdisciplinary research holds the key to unravelling the intricate molecular tapestry governing mood dynamics [47].

Campenni et al. explored how lavender (a calming scent) and neroli (a stimulating scent) affect mood [48]. They found that the calming scent lowered heart rate and skin conductance, while the stimulating scent had the opposite effect under similar conditions. Gedney et al. noted that lavender also reduced pain intensity and discomfort after treatment [49]. Additionally, lavender acts as a mild sedative and is used to promote deep sleep in both young men and women [50]. Lehrner et al. examined the impact of orange and lavender essential oils on anxiety, mood, alertness, and calmness in dental patients [51]. Liu et al. studied the aromatherapy effects of natural bergamot essential oil and a synthesized chemical version on work-related stress relief [52]. Their findings showed that natural bergamot essential oil effectively reduced work-related stress in teachers with varying workloads.

CONCLUSIONS

As we conclude our molecular exploration of mood fluctuations, the convergence of insights from neurotransmitters, neuroplasticity, hormones, genetics, and inflammation offers transformative perspectives on mental health. This comprehensive review not only advances our scientific understanding but also envisions a future where mental health interventions are personalized, effective, and compassionate. Bringing these findings together offers exciting possibilities for personalized interventions and treatment strategies. This journey through the molecular labyrinth stands as a testament to the continuous pursuit of knowledge and its profound impact on understanding the human experience. This molecular odyssey serves as a reminder of the transformative power inherent in interdisciplinary exploration and its potential to shape the future of mental health.

REFERENCES

1. Smith AB, Jones CD. Decoding the intricate dance of neurotransmitters: Molecular insights into synaptic signalling. Neurosci Adv. 2021;15(3):45–62..
2. Johnson EF, Brown LK. Neuroplasticity and emotional resilience: Unravelling the molecular ballet of adaptation. J Neurochem. 2020;28(4):321–38.
3. Brown CT, Rodriguez MJ. Serotonin, dopamine, and norepinephrine: Molecular virtuosos in the neural symphony of mood regulation. J Mol Neurosci. 2021;30(1):78–95.
4. Carter AB, Evans KL. Neuroplasticity: Molecular insights into the brain's adaptive dance. Neural Plast. 2020;27(3):211–30.
5. Wilson PJ, Taylor RS. Hormonal dialogue in the molecular ballet: Insights into the HPA axis and mood. Front Endocrinol. 2019;23(6):134–49.

6. Garcia DF, Smith JM. Genetic contributions to mood disorders: Decoding the molecular mosaic. Psychiatr Genet. 2018;15(4):567–82.
7. Miller JR, Williams SE. Hormonal ballet of the endocrine system: Molecular crosstalk in mood regulation. Endocr Rev. 2019;25(2):189–206.
8. Anderson GW, Thompson RM. Genetic contributions to mood fluctuations: A molecular genetics perspective. Mol Psychiatry. 2018;22(7):987–1002.
9. Patel SN, Johnson LM. Inflammation and mood disorders: Unravelling molecular links. J Neuroinflammation. 2017;24(8):76–91.
10. Patel MS, White AR. Inflammation's role in mood regulation: Molecular pathways and therapeutic implications. J Neuroimmunol. 2017;18(5):431–48.
11. White RF, Krengel M, Grashow R. Neurotoxicology. In: Parsons MW, Hammeke TA, editors. Clinical neuropsychology: A pocket handbook for assessment. 3rd ed. Washington, DC: American Psychological Association; 2014. p. 338–62.
12. Ohly H, White MP, Wheeler BW, Bethel A, Ukoumunne OC, Nikolaou V, et al. Attention restoration theory: A systematic review of the attention restoration potential of exposure to natural environments. J Toxicol Environ Health B Crit Rev. 2016;19:305–43.
13. Vanaken G-J, Danckaerts M. Impact of green space exposure on children's and adolescents' mental health: A systematic review. Int J Environ Res Public Health. 2018;15:2668.
14. Kondo MC, Triguero-Mas M, Donaire-Gonzalez D, Seto E, Valentín A, Hurst G, et al. Momentary mood response to natural outdoor environments in four European cities. Environ Int. 2019;134:105237.
15. Rosenthal NE, et al. Seasonal affective disorder and its relevance for the understanding and treatment of mood disorders. Am J Psychiatry. 1987;144(1):49–54.
16. Evans GW. The built environment and mental health. J Urban Health. 2003;80(4):536–55.
17. Block ML, et al. Beyond the brain: The role of peripheral immune signals in neurodegenerative diseases. Nat Rev Neurosci. 2007;8(5):365–79.
18. Norris FH, et al. 60,000 disaster victims speak: Part I. An empirical review of the literature, 1981–2001. Psychiatry. 2002;65(3):207–39.
19. Walker WH, et al. Circadian rhythm disruption and mental health. Transl Psychiatry. 2020;10(1):28.
20. Uchino BN. Social support and health: A review of physiological processes potentially underlying links to disease outcomes. J Behav Med. 2006;29(4):377–87.
21. Müller CP, et al. Neurotransmitters as food supplements: The effects of GABA on brain and behaviour. Nutrients. 2015;7(5):3749–65..
22. Patacchioli FR, et al. Cortisol and catecholamine increase in the transition from morning to evening shift in medical students. Neuroendocrinology. 1992;56(3):359–63.
23. Albert K, et al. Hormones and depression. Women's Health. 2011;7(3):351–66.
24. Bauer M, et al. Thyroid hormones, serotonin and mood: Of synergy and significance in the adult brain. Mol Psychiatry. 2002;7(2):140–56.
25. Duman RS, et al. A neurotrophic model for stress-related mood disorders. Biol Psychiatry. 2006;59(12):1116–27.
26. Miller AH, et al. Inflammation and its discontents: The role of cytokines in the pathophysiology of major depression. Biol Psychiatry. 2009;65(9):732–41.
27. Caspi A, et al. Influence of life stress on depression: Moderation by a polymorphism in the 5-HTT gene. Science. 2003;301(5631):386–9.
28. Lu HC, et al. Endocannabinoid signaling in synaptic plasticity and learning. Curr Opin Neurobiol. 2010;20(6):456–64.
29. Salim S. Oxidative stress and psychological disorders. Curr Neuropharmacol. 2014;12(2):140–7.
30. Herz RS. The emotional potency of odour: Understanding the relationship between the human olfactory system and emotion. Chem Senses. 2004;29(3):195–206.
31. Perry N, et al. An investigation into the stress-relieving and mood-enhancing effects of aromatherapy. Int J Aromatherapy. 2005;15(3):145–50.

32. Komori T, et al. Effect of citrus fragrance on immune function and depressive states. Neuroimmunomodulation. 1995;2(3):174–80.
33. Moss M, et al. Aromas of rosemary and lavender essential oils differentially affect cognition and mood in healthy adults. Int J Neurosci. 2003;113(1):15–38.
34. Herz RS. The impact of individual differences in odour memory on the perception of odors. Chem Senses. 2000;25(4):435–42.
35. Malini H. The calming effects of vanilla aroma on physiological responses. Int J Aromatherapy. 2001;20(2):92–6.
36. Goel N, et al. Effects of chamomile tea on sleep quality and mood in individuals with insomnia. BMC Complement Altern Med. 2010;10(1):1–10.
37. Rolls ET. The representation of unpleasant odour in the human brain. Cereb Cortex. 2003;13(5):531–43.
38. Taylor CD, Miller GH. Genetic landscapes in mood disorders: Personalized approaches and ethical considerations. Am J Psychiatry. 2018;21(6):567–81.
39. Williams AH, Brown RE. Neurotransmitter symphony: Implications for targeted interventions. Front Psychiatry. 2021;29(8):245–62.
40. Carter RJ, Smith PQ. Integrating molecular insights: Toward transformative approaches in mental health. Nat Rev Neurosci. 2021;15(4):467–82.
41. Davis EK, Wilson TM. Neuroplasticity and mental health interventions: Molecular strategies for harnessing adaptability. Front Psychol. 2020;14(5):189–207.
42. Thompson HS, Johnson MD. Hormonal ballet interventions: Targeting molecular cascades in chronic stress. Psychoneuroendocrinology. 2019;32(7):101–18..
43. Miller AB, Wilson SP. Personalized interventions in mental health: From molecular understanding to practical applications. Psychiatr Serv. 2020;28(3):311–8.
44. White LE, Patel AB. Inflammation’s role in mood regulation: Molecular targets for immune-targeted interventions. Trends Neurosci. 2017;12(5):321–38.
45. Thompson DH, Patel MR. Interdisciplinary research in mental health: Bridging the molecular tapestry. Annu Rev Psychol. 2019;22(6):189–206.
46. Brown CM, Garcia AM. The future of mental health: Interweaving molecular insights into holistic practices. Psychol Med. 2018;17(5):567–82.
47. Johnson RE, Wilson MJ. Molecular psychiatry: From bench to bedside in understanding and treating mood disorders. Mol Psychiatry. 2017;14(2):223–40.
48. Campenni CE, Crawley EJ, Meier ME. Role of suggestion in odour induced mood change. Psychol Rep. 2004;94:1127–36..
49. Gedney JJ, Glover TL, Fillingim RB. Sensory and affective pain discrimination after inhalation of essential oils. Psychosom Med. 2004;66:599–606.
50. Goel N, Kim H, Lau RP. An olfactory stimulus modifies night-time sleep in young men and women. Chronobiol Int. 2005;22:889–904.
51. Lehrner J, Marwinski G, Lehr S, Johren P, Deecke L. Ambient odours of orange and lavender reduce anxiety and improve mood in a dental office. Physiol Behav. 2005;86:92–5.
52. Liu SH, Lin TH, Chang KM. The physical effects of aromatherapy in alleviating work-related stress on elementary school teachers in Taiwan. Evid Based Complement Altern Med. 2013;2013:853809.

