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Editorial

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Editorial: Energy balances in biological systems

Muhammad Aqeel Ashraf

Department of Environmental Science and Engineering, School of Environmental Studies, China University of Geosciences, Wuhan, China; International Water, Air & Soil Conservation Society, Kuala Lumpur, Malaysia

Muhammad Faheem

Department of Environmental Science and Engineering, School of Environmental Studies, China University of Geosciences, Wuhan, China

Energy is generally described as the ability to perform work. Energy and energy conservation are very closely interconnected concepts: one cannot be explained without the other. Energy balance is defined as the relationship between energy intake and energy expenditure. Energy transformation always follows the basic laws of thermodynamics. In biological/living systems, little energy is consumed to derive metabolic processes, and the rest of it dissipates in the form of heat into the atmosphere.¹ However, overall energy remains conserved in the system and the apparently lost energy is converted into another form. Normally, the term bioenergetics is applied to express the energy flow pathway including energy consumption and generation in biological systems. All types of chemical reactions that take place in organisms are defined as metabolism. For example, different organisms such as algae, cyanobacteria and plants have the ability to produce carbohydrate compounds from carbon dioxide and water with the assistance of sunlight as an energy source.² This process is considered the fundamental route for the production of organic material in the biosphere. Furthermore, the hydrothermal vent-associated ecosystem expands beneath the oceanic floor, obtaining energy from methane (CH₄) and hydrogen sulfide (H₂S) chemical compounds.³ However, for each case the total energy balance equation has been applied for overall activities happening in the ecosystem.

$$\text{Energy intake} = \text{External work done} + \text{Internal heat produced} + \text{Stored}$$

There is a strong relationship found between nutrition intake and metabolism of biological/living systems. An increasing energy imbalance occurs when energy intake through various sources exceeds the external work done as well as other means of energy expenditure.⁴ In contrast, a decreasing energy balance situation prevails when energy intake becomes lower than what is expected to fulfill the external work need as well as for other energy expenditure routes.⁵ So, it can be said that the energy balance scheme is a potential tool for the deep understanding of weight regulation

occurring in biological/living systems. However, our potential to quantify each particular energy gain or energy expenditure of biological/living systems over extended time scales is very poor.

Therefore, it is important to understand that the energy balance framework is interactive and complex in nature: a slight change in one parameter has a strong potential to affect one or more other parameters in biological/living systems. So, there is a need to focus on long-term, longitudinal studies for a better understanding of the interaction between components of the energy balance framework and the variation happening in the composition of biological/living systems. Accordingly, it is a research gap to establish new approaches that can reliably measure energy balance components over extended time scales for biological/living systems. Additionally, it has been suggested that psychological and biological aspects also influence energy balance components in a free-living system; however, these factors have normally been investigated independently of one another. So, an integrative approach is needed for a better understanding and precise evaluation of the components and energy balance framework of biological/living systems to achieve the desired goals.

REFERENCES

1. Chabalengula VM and Mumba F (2012) Understanding energy conservation: intersection between biological and everyday life contexts. In *Energy Conservation* (Zain Ahmed A (ed.)). Intech, Rijeka, Croatia, ch. 3.
2. Hays SG and Ducat DC (2015) Engineering cyanobacteria as photosynthetic feedstock factories. *Photosynthesis Research* **123**(3): 285–295.
3. Sohl F, Choukroun M, Kargel J *et al.* (2010) Subsurface water oceans on icy satellites: chemical composition and exchange processes. *Space Science Reviews* **153**(1–4): 485–510.
4. Hall KD, Heymsfield SB, Kemnitz JW *et al.* (2012) Energy balance and its components: implications for body weight regulation. *The American Journal of Clinical Nutrition* **95**(4): 989–994.
5. Hall KD, Sacks G, Chandramohan D *et al.* (2011) Quantification of the effect of energy imbalance on bodyweight. *The Lancet* **378**(9793): 826–837.