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Short Communication

Bernoulli-Venturi Flow Principles Rules Out filtration as Daphnia`s Feeding Mechanism: Supplemental Evidence

Moshe Gophen*

Tel Hai University of Kiryat Shmona in the Galilee, Israel

***Corresponding author:** Moshe Gophen, Tel Hai University of Kiryat Shmona in the Galilee, POB 831 Kiryat Shmone, Israel (11016).

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Abstract

Feeding mechanism of Daphnia that has been historically described as a sieving action [1-4] is replaced by mechanism of assembling [5-11]. The sieving mechanism was a circumstantial definition because causal strictly observed and documented was never confirmed. The application of cinematographic methodology and fluid dynamics analyses confirmed a turning point, shifting from sieving to assembly mechanism, [5-11]. Sieving through numerous pores, dictate enhanced velocity in each and further retreats to slower velocities beyond. Pores diameter constriction induces higher velocity and lower pressure. Nevertheless, continuous, unchanged velocity flow of Particles Contained Fluid Solution PCFS through the Filter Chamber (FC) [1-3] is required to ensure optimal synchronized adaptation between two separate internal laminar micro- currents (MF, LF) flows, whereas sieving action predict turbulence disturbances.

Keywords: Bernoulli, Venturi, Daphnia, Sieving, Assembly

Material and Methods

A cinematographic study was carried out using a high-speed camera (Photo-Sonics 4C; 250 frames/second) operated through three dimensions (left-right, forward-backward, and up-down) fixed microscopical lenses. The dorsal side of a tethered Daphnia magna (Straus, 1820) (3.7mm, length) was glued (Bostic Superglue 4-Cyanoacrilate) onto the tip of a rigid plastic sieve in- side a 50 ml glass container full of filtered (0.45µm filter paper) lake (Bodensee, Germany) water. The internal water flow within the space between the two transparent carapace valves was detected by a mini drop of Indian Ink, which was injected (superfine screw-thread injector) into the water media close to the animal intake location [12,13]. Analysis of the resulting film was carried out by a slow-motion projection, accompanied. by a time-motion analyzer, of a single frame-by-frame (10 millisecond intervals) and magnified solid photos. A visual indication of fluid penetration through P3 and P4, transported from the inner to the outer surface [6].

Introduction

The application of cinematographic technology enabled the definition of two separate water-current flow routes within the Daphnia`s internal space [1,5-8]: 1) The Lateral Flow (LF), which starts underneath P2 and flows backward towards the distal body part along the carapace edge; and 2) The Median Flow (MF), which originates in the proximal body part (head) and flows downward between thoracic P3, P4 and then turns tangentially in the direction in the space between P3 and P4 limbs before being expelled externally. The operational activities of LF and MF are synchronized and occur alternately [5,6,11]. The cinematographic technologies and re-evaluation of fluid dynamics principles (Bernoulli and Venturi principles) supported the enclosed commentary completed remarks of assembling definition of the Daphnia`s feeding mechanism.

Undisturbed fluid-flow velocity is a characteristic feature of Laminar flow, whereas water mass transition through a narrower passage, as predicted by sieving action, results in low velocity reduction that may generate erratic turbulent flow. Laminar flow enables optimized coordination between the LF and MF current-management systems. The operational mechanism of the trunk limbs consists of a rhythmic pulsated stroke beat that transfers water lumps through the "filter chamber" (FC) [1-3] from the proximal to the distal body part. Coordination is maintained between the two microcurrents, whereas filtering might cause system disturbances. Coordinated operational strokes driven by the trunk limbs alternatively generate a uniform smooth laminar LF and MF water flows throughout the entire route: from the entrance, sorted between LF and MF and forwarded within the internal carapace volume and expelled posteriorly without a cross through a sieving structure [5-7,11]. If sieving were the operative mechanism, Bernoulli & Venturi water flow principles [12] indicate flow velocity enhancement through the "filters" (setula) relative to the previous speed within the "filter chamber" on the free-flowing space on the downstreamr side. Such velocity changes would produce flow irregularities which could serve as a source of interference and distortion in the coordination of the microcurrents.

Results and Discussion

Considering the flow of food particles contained fluid solution (PCFS) through Daphnia`s internal spaces as a tiny hole flush and the existence of the physical rule of energy conservation, the Bernoulli-Venturi principles are relevant. Consequently, a narrower passage space (orifice tube) results in higher velocity and pressure decline. Continuous, unchanged velocity flow of PCFC (the MF route) through the FC [1-3] is required to ensure optimal synchronized adaptation between MF and LF. Nevertheless, operational sieving of PCFC through numerous tiny micropores (setule fibers) [5-8,10-14] creates modified current velocities. The P3 downward beat results in PCFC suction into the FC and in a row continuation, the upward beat causes pressurized squeezing of PCFC exit. During the PCFC flow through the FC, food particles come into contact with the Setula`s fibers and stick to them. Therefore, the assembly of food particles is a more suitable definition for the feeding mechanism of Daphnia. Though the flow should progress smoothly in order to adapt to the MF and LF alternating flow system. Nevertheless, if sieving action is operated where PCFC penetrates through numerous micropores which enhance velocity in each narrower passage, synchronization disruption is predicted. Discrepancy between LF and MF enhances distortion and possibly energetic waste. P3's downward beat sucked PCFC, dictating a slower velocity than that created by numerous micropores resulting from an unchanged pressurized amount of energy. When sucked into the FC, the PCFC flow velocity, without sieving, is equal to its outflow when P3 moves upward.

Bernoulli @ Venturi Principles Deny Sieving Action

Nevertheless, if sieving occurs through numerous pores, where in each velocity is shortly enhanced and further retreats to slower velocities later. Space diameter constriction, i. e., micropore sieving, induces higher velocity and lower pressure (Bernoulli Principle) [12]. Taking into account the existence of numerous micropore passages, a significant distortion of the optimal internal flow system is predicted. Conclusively, the continuity of a laminar flow direction and fluency was cinematographically confirmed, whereas vibration and/or velocity turbulence disturbances were not [12].

If sieving action exists, the pressure on both sides (internal, external) of the micropore is the same, but lower inside the pore passage, resulting in turbulence when PCFC exits the pore tube into the FC space. When PCFC flows from the high-pressured wide diameter (FC space) into the pore`s low-pressured narrower diameter (Bernoulli principle) and exits again into the wider FC space diameter, [12] turbulence is created. The resulting flow vibrations were not confirmed by cinematographic film. Predicted possible vibrations resulting from turbulence caused by sieving were not confirmed. Moreover, the inlet flow velocity into the pore passage is lower than the outlet and turbulence creation is predicted but denied by cinematographic film.

Fluid velocity increases and its static pressure decreases as it flows through a narrower diameter of a pipe: Velocity increases and pressure drops [12].

A combined Bernoulli and Venturi principle resulted in the following:

P_1-P_2 = 1\2 p ($V2^2$-$V1^2$)

Where:

P = Static pressure of water, potential energy;

p=Water density;

V=Flow velocity

The maintenance of constant volumetric flow velocity is dictated by the continuity of the equation, $P_1V_1=P_2V_2$ which can exist without sieving action.

Summary

The sieving mechanism was a circumstantial definition because causal strictly observed and documented was never confirmed. The application of cinematographic methodology and fluid dynamics analyses confirmed a turning point, shifting from sieving to assembly mechanism,

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Competing Interests

The author have no conflict of interest that may affect this article.

Data Availability

All the data generated and/or analyzed during performing this current study are available upon request.

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Contributions

Paper constructing and writing by the author.

K. Kolhage M. Gophen, and W. Geller cooperated in production of the Cinematographic system.

References

1. Fryer G (1987) The Feeding Mechanisms of the Daphniidae (Crustacea: Cladocera): Recent Suggestions and Neglected Considerations. Journal of Plankton Research 9: 419-432.
2. Fryer G (1991) Functional Morphology and the Adaptive Radiation of the Daphniidae (Branchiopoda: Anomopoda). Philosophical Transactions: Biological Sciences 331: 1-99.
3. Fryer G (1995) Phylogeny and Adaptive Radiation within the Anomopoda: A Preliminary Exploration. In: Larsson, P. and Weider, L.J., Eds., Cladocera as Model Organisms in Biology, Springer 57-68.
4. Brendelberger H, et al (1986) Daphnia's Filters Are Not Solid Walls. Archiv für Hydrobiologie 107: 197-202.
5. Gophen M (2014) Cinematographic Analysis of Internal Water Flows in Daphnia. Journal of Experimental and Agricultural Sciences 2: 501-507.
6. Gophen M (2022) Internal Water Flows and Particles Abstraction in Daphnia. Open Journal of Ecology 12: 742-755.
7. Gophen M (2024) Assembling and Dewatering of Food Particles in Daphnia. AM J Biomed Sci Res 24(6): 631-635.
8. Gophen M (2026) Retrospective Forthrightness Scientific Farewell - Daphnia Is Not a Filter Feeder: Innovative Review. Open Journal of Modern Hydrology 16: 1-14.
9. Gophen M, Geller W (1984) Filter Mesh Size and Food Particle Uptake by Daphnia. Oecologia 64: 408-412.
10. Gerritsen J, et al. (1988) Not by Sieving Alone: Observations of Suspension Feeding in Daphnia. Bulletin of Marine Science 43: 366-376.
11. Kolhage K (1995) Water Flows in Daphnia. 87th Proceedings of the German Zoological Society, Jena, 23-28.
12. Vogel S (1988) Chapter: Chapter 7: Pressure and Flow, pp 130-157; in: Life`s Devices The Physical world of animal and plants; Princeton University Press, Princeton, N. J.
13. Strickler, J R (Rudi) A Purpora, A Talioua, M Gophen, J Sheng (2024) 77th Annual Meeting of the APS Division of Fluid Dynamics 24-26.
14. Gophen M (1999) Internal Water Flows in Daphnia reduction of outflow vibration together with particle intake. The 5th conference on Cladocera Plon, Germany held on 14-18.