Solid and dissolved organic waste formation

Grant Kinkead
Independent Researcher, Melbourne, VIC, Australia
grant@kinkead.au

***Abstract*—Fish feed is a starting point for explaining waste formation in aquaponic systems. Feed that is not assimilated may remain as uneaten feed, pass through fish as faeces, or contribute to soluble excretion. Fish waste and uneaten feed may subsequently undergo microbial decomposition. This paper distinguishes those initial routes from later transformation so that the presence of waste in particulate and dissolved forms is not attributed to a single process. The available review evidence supports a causal account of feed-derived solids and soluble waste, but it does not, within the evidence assessed here, establish the chemical composition of every dissolved fraction, the proportion attributable to each route, or the rate at which decomposition changes those fractions. In particular, soluble excretion cannot be treated without qualification as a measurement of dissolved organic waste. A defensible account therefore identifies the origin and possible transformation of waste while keeping claims about composition and magnitude separate. This distinction provides a basis for interpreting the scientific meaning of solid and dissolved organic waste formation without assigning unsupported values or mechanisms.**

I. Introduction

Solid and dissolved organic waste formation begins with the fate of material introduced as fish feed. A review of aquaponic systems identifies uneaten feed, faeces and soluble excretion as distinct outcomes when feed is not fully assimilated [1]. The distinction matters because the three outcomes do not describe the same physical route into the system: feed can remain uneaten, pass through the fish, or be released in soluble form. Treating all waste as though it were created by a single route would obscure this causal sequence. The review supports an explanation of where several waste streams originate, although its account alone does not quantify their relative contributions.

The term solid waste is most directly connected here with uneaten feed and faeces, while soluble excretion establishes that material can also enter the water without first being identified as a solid particle [1]. That contrast is useful, but it requires care. A description of material as soluble does not, by itself, identify all of its chemical constituents as organic. Likewise, recognising faeces and uneaten feed as sources of solids does not establish how much of either persists in particulate form. The question is therefore not simply whether waste is produced, but which claims about its physical form and composition the available evidence can sustain.

Waste formation also has a temporal dimension. The same review describes microbial decomposition of fish waste and uneaten feed, placing biological transformation after the initial production or introduction of those materials [1]. An account confined to excretion would miss that later stage; an account confined to decomposition would miss the feed-derived origins of the material being transformed. This paper first defines the relevant boundaries, then examines the initial waste routes and subsequent decomposition, and finally assesses what can and cannot be concluded about dissolved organic waste from the available evidence. Its central argument is that origin, physical form and later transformation must be distinguished rather than collapsed into one description.

II. Background and Scope

The available review connects waste formation to an input and several resulting streams: fish feed may remain uneaten, contribute to faeces after passage through fish, or be associated with soluble excretion [1]. These are complementary parts of one causal account, not competing explanations. Uneaten feed identifies material that did not enter the fish, whereas faeces and soluble excretion identify different outcomes following the feeding process. This distinction gives solid and dissolved waste formation a clearer starting point than the undifferentiated label 'fish waste'. It also limits inference: the review supports the existence of these routes, but the evidence assessed here does not establish how much material follows each one.

Physical form and route of formation answer different questions. Uneaten feed and faeces provide identifiable sources of solid material, whereas soluble excretion identifies a route by which material enters in dissolved form [1]. Describing these routes separately helps prevent a misleading inference that all dissolved material must have originated through breakdown of solids. Conversely, the review's account of microbial decomposition means that the significance of an initially solid stream cannot be judged solely at the moment it appears. The supported explanation is thus a sequence with more than one entry route and a subsequent transformation process, not a fixed division in which every material remains in its initial form.

The scope of this synthesis is deliberately narrower than a complete chemical account of aquaponic water. The review identifies soluble excretion and microbial decomposition, but the accepted evidence available for this paper does not specify the organic constituents of the soluble stream or demonstrate which dissolved products arise from decomposition [1]. It would therefore be unsound to use 'dissolved organic waste' as an exact synonym for all soluble excretion. The gap is consequential for interpretation: the origin of a dissolved stream can be explained from the review, while its organic composition remains insufficiently established here. No claims

about concentrations, conversion rates or the balance between the streams follow from this evidence alone.

III. Core Concepts and Mechanisms

The first formation route is feed that remains uneaten. Because it has not been assimilated, this material can be recognised as a direct feed-derived contribution to solid waste rather than as an excretion product. The review lists uneaten feed alongside faeces and soluble excretion when describing the consequences of feed input [1]. This matters causally: a solid may appear without first passing through the fish. It also matters when interpreting the expression 'fish waste', which can otherwise conceal the difference between material left after feeding and material released by the animal. The available evidence establishes this distinction but does not state the quantity or persistence of uneaten feed.

A second route is the formation of faeces from feed that is not assimilated after ingestion. The review identifies faeces as an outcome distinct from uneaten feed and soluble excretion [1]. Its distinct origin explains why the presence of solid waste cannot be attributed exclusively to feed left uneaten, even though both routes begin with feed input. At the same time, the evidence does not justify assigning a particular composition to faeces or treating all feed that enters the fish as eventually appearing in this stream. The defensible conclusion is more precise: faeces provide another identifiable source of solids, while the proportions and constituents require evidence beyond the accepted account.

Soluble excretion provides a third route and establishes that not every waste stream begins as an identifiable solid. The review places soluble excretion beside faeces and uneaten feed in its description of feed-derived outcomes [1]. That placement supports a distinction between direct release in soluble form and the production of solid material, but it does not resolve the chemistry implied by the phrase 'dissolved organic waste'. Solubility describes physical behaviour, whereas 'organic' makes a compositional claim. Without evidence specifying the constituents of the soluble excretion, the route can be explained, but the organic share of that dissolved material cannot be asserted or quantified.

IV. Evidence Synthesis

The three initial routes account for different ways in which feed-derived material can remain in, or enter, an aquaponic system. Uneaten feed and faeces identify sources of solids, while soluble excretion identifies a separate soluble pathway [1]. Considered together, they show why a simple opposition between 'feed' and 'fish waste' is inadequate: feed can itself remain as waste, and material associated with feeding can also emerge through the fish in different forms. The review supplies the relationships needed for this qualitative explanation. It does not supply, within the accepted evidence, a mass balance that would establish which route predominates or how the routes vary.

Initial formation is not the entire account because fish waste and uneaten feed may undergo microbial decomposition [1]. This later process makes it necessary to distinguish the source of material from its subsequent condition. A description of faeces or uneaten feed as solid waste identifies an origin and an initial form; it is not a claim that the material remains unchanged. Equally, the existence of decomposition does not by itself establish which dissolved organic compounds result or how much particulate material is transformed. The evidence supports a linked explanation, beginning with feed-derived streams and continuing through microbial action, while leaving the detailed products of that action unresolved.

Read together, the supported claims yield a causal account with two separate kinds of uncertainty. The routes by which uneaten feed, faeces and soluble excretion arise are identified, and decomposition of fish waste and uneaten feed is described [1]. What remains uncertain is both quantitative, concerning the amounts associated with each route, and compositional, concerning the identity of dissolved organic material. Those uncertainties should not erase the supported mechanism, but neither should the mechanism be used as a substitute for measurements it does not provide. The strongest conclusion is therefore about relationships among inputs, waste streams and later transformation, rather than a complete inventory of waste constituents.

V. Practical Implications and Limitations

A useful interpretation of solid waste formation should retain the distinction between uneaten feed and faeces. Both are identified in the review, but one is feed remaining after feeding and the other is material released after passage through the fish [1]. Keeping those origins separate makes observations of solids more intelligible without assuming that their amounts or compositions are identical. It also prevents an unsupported conclusion that observing a solid reveals which route produced it. The accepted evidence provides a framework for asking that question, not a means of answering it for a particular system without further information about the observed material.

Interpretation of dissolved organic waste requires an additional boundary. Soluble excretion is an evidenced pathway for material entering the water in soluble form, and microbial decomposition of fish waste and uneaten feed is also described [1]. Neither point, as represented in the accepted evidence, specifies the organic fraction of the dissolved material or separates direct excretion from possible products of later transformation. A claim about dissolved organic waste should therefore identify whether it concerns a demonstrated constituent, a proposed origin, or merely material known to be soluble. The distinction avoids presenting a plausible relationship between waste streams as a measured chemical result.

The principal validation need follows directly from these limits. The review supports the qualitative feed-to-waste routes and the occurrence of microbial decomposition, but the accepted evidence does not provide route-specific amounts, dissolved organic composition, or rates of transformation [1]. Resolving those questions would require evidence that distinguishes the relevant streams and identifies the material being

characterised. Until such evidence is available, the account should be used to explain why solids and soluble waste can arise and why their forms may change, rather than to predict a concentration, assign a conversion fraction, or make a system-specific performance claim.

VI. Conclusion

Solid and dissolved organic waste formation is best understood as a sequence of distinct origins and possible later transformation. Feed that is not assimilated can remain uneaten, contribute to faeces, or be associated with soluble excretion; fish waste and uneaten feed may then undergo microbial decomposition [1]. This account explains why solids cannot be assigned a single origin and why soluble material need not be presumed to have arisen from the breakdown of solids. Its value lies in making the causal relationships explicit while preserving the difference between an observed or described physical form and a demonstrated chemical composition.

The evidence supports that qualitative explanation but not a complete characterisation of dissolved organic waste. In particular, the accepted account does not establish which constituents of soluble excretion are organic, which dissolved products result from decomposition, or the amounts associated with any route [1]. The most valuable next evidence would identify the composition and relative contributions of the streams already distinguished here. Until then, claims about organic composition or the magnitude of transformation should remain qualified. Such restraint does not weaken the causal explanation; it marks precisely where that explanation ends and where additional observation must begin.

Acknowledgment

The author used artificial intelligence tools to assist with manuscript drafting and revision, and with LaTeX and bibliography preparation. The author reviewed all AI-assisted output and remains responsible for the final content.

References

[1] M. Krastanova, I. Sirakov, S. Ivanova-Kirilova, D. Yarkov, and P. Orozova, "Aquaponic systems: biological and technological parameters," *Biotechnology & Biotechnological Equipment*, 2022.