WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Muscle–Gut Axis: An Emerging Concept Through the Ayurvedic Lens of *Mamsa Dhatu* and *Agni*

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ABSTRACT :

Modern research increasingly describes two-way communication between the gut microbiota and skeletal muscle, often called the muscle–gut axis. The evidence comes mainly from animal experiments and small observational human studies, and it is most relevant to sarcopenia and frailty. Ayurveda holds that the quality of tissue nourishment depends on the strength of digestion (*agni*), and that *maṃsa dhatu* (muscle tissue) is formed in sequence from the essence of digested food under the action of its own tissue-specific fire (*maṃsagni*). This article compares the two frameworks, identifies where they converge, and states where the comparison must remain cautious. The main points of convergence are that muscle quality depends on upstream gut function, and that muscular activity in turn supports digestive and metabolic fire. The limits are equally important: *agni* is not equivalent to the microbiome, classical descriptions were not written against modern endpoints, and clinical evidence for *Ayurvedic* interventions on muscle outcomes is sparse. The convergence is presented as a source of testable hypotheses, not as evidence of equivalence or of clinical benefit.

Keywords: muscle–gut axis,gut microbiota, sarcopenia, *maṃsa dhatu*, *agni*,*vyayama.*

1. Introduction

Skeletal muscle was long regarded as a purely mechanical tissue, and the gut as a digestive organ. Both views have been revised. Muscle is now recognised as a secretory organ that releases signalling molecules known as myokines.[1] The gut is recognised as a dense microbial ecosystem that influences metabolism, immunity and inflammation throughout the body [2]. The "muscle–gut axis" refers to the crosstalk between the two, and it has attracted particular attention in relation to age-related loss of muscle mass and function.[2,3] Sarcopenia, the clinical condition of low muscle strength together with reduced muscle quantity or quality, is defined by consensus criteria that give priority to muscle strength. [4]

Ayurveda expresses a parallel idea in its own vocabulary. Its classical texts hold that each body tissue (*dhatu*) is nourished from the essence of digested food, so that the quality of digestion determines the quality of the tissues that follow.[5]This article sets the two frameworks side by side, with a focus on muscle. It is an interpretive comparison. It does not claim that Ayurvedic concepts and microbiological findings describe the same phenomena.

2. The Muscle–Gut Axis in Modern Science

Several lines of evidence support the concept. Most of it is preclinical or observational.

- **Microbial metabolites.** Short-chain fatty acids (SCFAs), chiefly acetate, propionate and butyrate, are the main products of microbial fermentation of dietary fibre. Reviews describe effects of SCFAs on lipid, carbohydrate and protein metabolism in muscle and a possible role in exercise capacity, with human evidence still limited.[6]
- **Animal studies.** Germ-free mice show muscle atrophy, reduced expression of genes linked to muscle growth and mitochondrial function, and altered amino acid profiles compared with mice that have a normal microbiota. Transplanting a microbiota into germ-free mice, or treating them with SCFAs, partly reversed these deficits.[7]
- **Barrier function and inflammation.** Ageing-related dysbiosis has been linked to increased intestinal permeability, which allows bacterial endotoxin (lipopolysaccharide, LPS) and other microbial products to enter the circulation and promote inflammatory signalling and muscle changes characteristic of ageing.[2]
- **Protein handling and anabolic resistance.** Anabolic resistance is the blunted muscle protein synthetic response to protein feeding or physical activity in older adults. A review proposes that age-related microbial change may influence it through protein digestion, amino acid absorption, circulating amino acid availability and anabolic signaling.[8] This remains a hypothesis.
- **Older adults.** In 178 elderly people, gut microbiota composition tracked with frailty, and diversity was lower in those in long-stay residential care than in community dwellers.[9] A 2019 narrative review noted that no study had yet targeted the human microbiome associated with sarcopenia. [3]A small case–control study of 35 community-dwelling adults aged 70 or over has since reported differences in some bacterial taxa between people with and without physical frailty and sarcopenia, but these findings are preliminary.[10]
- **The reverse direction.** Professional rugby players showed greater gut microbial diversity than controls, but their diets also differed markedly,

so the effect of exercise cannot be separated from that of diet.[11] In marathon runners and elite athletes, *Veillonella* increased after exercise, and a strain isolated from runners improved treadmill run time in mice by converting lactate to propionate. [12]

3. Maṃsa Dhatu in Ayurveda

The classical texts describe seven tissues (*sapta dhatu*) formed in sequence: *rasa*, *rakta*, *maṃsa*, *meda*, *asthi*, *majja* and *sukra*.[5] *Maṃsa* is the third, formed from *rakta*. Its recognised functions include giving bulk and support to the body and nourishing the next tissue, *meda* (Su.Su.15).[13] Its channels (*maṃsavaha srotas*) are rooted in the *snayu* (ligaments and tendons), the *tvak* (skin) and the blood-carrying vessels (*raktavahi dhamani*).[5]

Maṃsa kṣaya (depletion) is described as wasting and dryness of regions such as the buttocks, cheeks, thighs and neck, accompanied by weakness, fatigue and laxity of the vessels.[13]. In a loose clinical sense this resembles sarcopenia, but the classical description is symptomatic and was not built around the strength, mass and performance measures used in modern criteria [4]. Vitiation of *maṃsa* is linked in Caraka's account to growths and swellings such as *arbuda* and *gaṇḍamala*. [5].

Maṃsa dhatu is a broader concept than skeletal muscle alone. The comparison in this article is functional, not anatomical.

4. Agni: The Transformative Gatekeeper

Ayurveda describes several tiers of *agni*. *Jaṭharagni*, the digestive fire seated in the *grahaṇi*(commonly identified with the small intestine), is the chief. Below it are the five *bhutagni*, acting on the elemental constituents of food, and the seven *dhatvagni*, one for each tissue.[5]

Food is first transformed by *jaṭharagni* into *ahara rasa*. Each *dhatvagni* then acts on the essence passed to its tissue and yields the next. The commentarial tradition explains this sequence with three analogies (*nyaya*): *kṣira-dadhi* (milk turning into curd, each tissue transforming into the next), *kedari-kulya* (water carried through irrigation channels to successive fields) and *khale-kapota* (pigeons at a threshing floor, each taking what it needs) [5].

When *agni* is weak (*mandagni*), incompletely processed material called *ama* accumulates. It is described as sticky, heavy and obstructive to the *srotas*[5]. On this view, poor *jaṭharagni* yields poorly formed *ahara rasa*, and poor *maṃsagni* impairs the formation and quality of muscle tissue even when the diet appears adequate.

5. Where the Two Frameworks Meet

Table 1 sets out proposed conceptual correspondences. These are the author's interpretive mappings offered for hypothesis generation. They are not established equivalences.

Table 1. Proposed correspondences between *Ayurvedic* concepts and modern constructs (interpretive).

Ayurvedic concept	Possible modern parallel (hypothesis)
Jaṭharagni / grahaṇi	Digestion, absorption, gut microbial fermentation
Quality of *ahara rasa*	Amino acid, micronutrient and metabolite availability
Ama	Dysbiosis, endotoxaemia, low-grade inflammation
Maṃsagni	Muscle protein turnover, mitochondrial function
Maṃsa kṣaya	Sarcopenia, anabolic resistance
Srotorodha	Impaired nutrient and signal transport

Both systems share the view that tissue health depends upstream on gut function, and both treat the relationship as a process rather than a set of isolated organs [3,5].

6. The Return Path: Vyayama

The axis runs in both directions, and so does classical *Ayurveda.* Caraka describes *vyayama* (exercise) as producing lightness (*laghava*), work capacity, stability, tolerance of discomfort, reduction of the *doṣas* and increase of *agni* [5]. This is a classical statement that muscular activity improves digestive and metabolic fire. It is comparable in spirit to the observation that exercise is associated with differences in gut microbial diversity and function, although the human evidence is confounded by diet [11,12].

The texts also advise moderation. Exercise is to stop short of exhaustion, and in the sources summarised in the limit of half one's capacity (*ardha-sakti*) is given for strong people accustomed to a fat-rich diet, in the cold seasons and in spring, with lighter effort in other seasons [14]. This is consistent with the modern finding that strenuous exercise can transiently impair gastrointestinal integrity and function, an effect described as reversible [15].

7. Practical Implications

An Ayurvedic approach to preserving muscle would address the gut first. The following are traditional and hypothesis-generating suggestions, not treatment protocols.

1. **Kindle agni.** *Dipana* (appetiser) and *pacana* (digestive) measures include ginger, *pippalī*and *trikatu* [5]. *Takra* (buttermilk), a fermented food, is classically indicated in *grahaṇī* disorders [5]. Triphala, a classical formulation, altered the growth of bacterial taxa in laboratory cultures of stool from 12 healthy donors, which is *in vitro* evidence of prebiotic-like activity and not a clinical result [16].
2. **Nourish the tissue.** *Bṛṃhaṇa* (nourishing) foods such as milk, ghee, *maṣa* (black gram), wheat and, for non-vegetarians, *māṃsa rasa* (meat broth) are traditionally used [5]. Heavy foods are classically matched to digestive capacity, which is why *agni* is addressed first.
3. **Use balya herbs.** *Balya* (strength-promoting) herbs form a classical category [5].Ashwagandha (*Withania somnifera*) was associated with greater gains in muscle strength and size than placebo in an 8-week randomised, double-blind trial of 57 healthy young men beginning resistance training [17].A further small trial of an aqueous extract with resistance training has also been reported [18]. Because the first trial enrolled young men only, its relevance to older or sarcopenic adults is uncertain.
4. **Exercise appropriately.** Regular, moderate *vyayama*, adjusted for age, season and constitution .

8. Limitations

- *Agni* is not the microbiome. It is a broader concept covering all metabolic transformation, and the mapping is analogical, not one-to-one.
- Classical descriptions were not designed to be tested against modern endpoints, and clinical research on *Ayurvedic* interventions for muscle outcomes is small and methodologically limited.
- The muscle–gut axis itself is still emerging. Most data are mechanistic, from animals, or observational, and human interventional evidence is limited [3,6,8].
- Herbal products are not free of risk and can interact with medication. *Ayurvedic* measures should complement, not replace, evidence-based care for sarcopenia, malnutrition or gastrointestinal disease, and advice should come from a qualified practitioner.

9. Conclusion

The muscle–gut axis and the *agni–maṃsa dhatu* relationship reach a similar conclusion from different starting points: muscle quality depends on what happens in the gut, and muscle activity feeds back to gut function. This convergence suggests studies that could be designed and tested. Examples include microbiome profiling before and after *Ayurvedic dipana* regimens, trials of *balya* herbs on muscle outcomes in older adults, and tests of whether measures of *agni* track with inflammatory and muscle markers. Until such work is done, the *Ayurvedic* lens is best used as a source of testable hypotheses.

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