

## Dairy Protein and Muscle Mass in the Elderly



# NDC & FHI: Communicating Dairy Nutrition Research

Health and wellness represents a significant area of opportunity for the dairy industry. The importance of healthy eating is constantly being emphasised, with consumer interest in natural, sustainable and nutritious foods increasing. While the matrix of nutrients offered by milk presents a unique and valuable addition to the diet, science is also indicating a beneficial role of dairy/dairy constituents with regard to a number of diet-related chronic diseases. Through this new-look *DN Forum*, we - the National Dairy Council (NDC) and Food for Health Ireland (FHI) - aim to highlight this dairy nutrition research: and by doing so, demonstrate the many benefits associated with dairy/dairy components; facilitate the effective dissemination of pertinent dairy nutrition research; and support the application of such research by the industry. The NDC has a long-established role in the communication of dairy nutrition research and educating various stakeholders on the benefits of dairy as part of a balanced diet and healthy lifestyle. Over the years, the NDC has developed numerous nutrition-based marketing campaigns for consumers, education initiatives for health professionals and information events and resources for industry. The FHI consortium unites top-class scientific expertise and dairy industry commercial knowledge with the aim of developing dairy-related functional food ingredients and products. Commenting on the merging of the expertise of the NDC and FHI through this

publication, Jens Bleiel, CEO of FHI, said: "FHI welcomes this collaboration with the NDC. The exciting research on dairy and its components that we do in FHI needs to be translated and communicated in an effective manner to the dairy industry, its global food customers and their consumers. This is the NDC's strength and in this sense our collaboration is complementary and generates important benefits for all stakeholders." In this specific edition of *DN Forum*, the focus is on the potential of dairy protein in the preservation of muscle mass in the elderly. Sarcopenia, the age-related progressive decline of skeletal muscle mass, can result in significant and far reaching consequences including mobility problems, disability and loss of independence. Although many factors are implicated in sarcopenia, the role of dietary protein is one nutritional factor which is being evaluated. Indeed, protein 'quality' appears to be key in muscle protein synthesis, with research also revealing specific potential regarding the essential amino acid leucine. Consequently, scientific evidence is pointing to potential advantages of dairy protein in this area. And, as further work continues to evaluate approaches for the management of age-related loss of muscle mass - including the type and quantity of dietary protein intake - the potential benefits of dairy protein should be acknowledged and evaluated further.

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### EDITORIAL

Welcome to the first edition of *DN Forum* for 2013! And welcome to the new format of *DN Forum*!

Since 2009, the NDC has produced 10 editions of *DN Forum*, providing in-depth scientific reviews on a variety of health topics in relation to milk and milk products. Following an evaluation, and coinciding with the recently launched NDC three-year strategy - *Irish Dairy: Sustainable and Nutritious by Nature* - we have re-vamped this communication tool to produce a more concise and focused publication aimed at increasing its appeal and effectiveness.

Under this new format, the NDC will work with Food for Health Ireland (FHI) to communicate dairy nutrition research - increasing the general awareness and acceptance of the broad benefits of dairy/dairy components; while also assisting industry innovation within the health and wellness category. As such, each edition of *DN Forum* will provide an independent review of a topic of interest, as well as notifying readers of NDC events that will complement the NDC-led discourse on dairy nutrition.

In this specific edition, we are delighted to present the expert contribution from Catherine Norton and Philip Jakeman, Food for Health Ireland and University of Limerick, focusing on the potential contribution of dairy protein to the preservation of muscle mass in the elderly.

As always, feedback and suggestions welcome ([nutrition@ndc.ie](mailto:nutrition@ndc.ie)).

*Catherine Logan*

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# Foreword

Healthy and successful aging is currently a pertinent issue and, considering the unprecedented projections regarding population aging, developments and interventions aimed at optimising healthy aging will remain a high priority. Among the associated health concerns is sarcopenia, the age-related progressive decline of skeletal muscle mass, and the complications which may arise as a result. Nutrition is among the factors implicated in this age-

related loss of muscle mass, with a body of scientific research evaluating the role of dietary protein. Evidence is pointing to potential benefits of dairy protein with this regard. Below, Catherine Norton and Philip Jakeman, Food for Health Ireland and University of Limerick, provide an independent overview of the science relating to dairy protein and the preservation of lean tissue mass in the elderly.

## The Contribution of Dairy Protein to the Preservation of Lean Tissue Mass in the Elderly

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Prof. Philip Jakeman

KEY WORDS: PROTEIN INTAKE, DAIRY PROTEIN, MUSCLE PROTEIN SYNTHESIS, SARCOPENIA, ELDERLY.

### Introduction

Sarcopenia is the term given to the progressive decline in lean tissue mass that occurs in aging<sup>1</sup>. When sarcopenic losses reduce skeletal muscle mass below a critical threshold, activities of daily living are compromised and disability can occur. With a prevalence of sarcopenia of 5–13% in people over 60 years of age, the projection is for >200 million sarcopenic adults by the year 2050<sup>2</sup>. The cause of sarcopenia is multifactorial and includes nutrition, physical activity, anabolic resistance and inflammation<sup>3</sup> (**Figure 1**). From a nutritional perspective, recent research suggests that the quantity, type and timing of dietary protein intake, specifically dairy protein, may have a significant effect on the progression of age-related sarcopenia.

### Dietary Protein Intake and Muscle Protein Synthesis

The amount<sup>4</sup>, amino acid composition<sup>5</sup> and distribution of protein intake in the daily diet<sup>6,7</sup> are implicated in the preservation of lean tissue mass in aging. The current recommended daily allowance (RDA) for adults of 0.8g/kg body mass/day was established by the Institute of Medicine (IOM) on the basis of short-term nitrogen balance studies in young adults<sup>8,9</sup> and it is, as yet, unclear whether the aging adult requires an increase in dietary protein requirement to offset the decline in lean tissue mass. Several recent studies argue for a moderate increase in daily protein intake to 1.0–1.3g/kg body mass<sup>6,10–13</sup> but this has not received universal support. An alternative approach has been to pursue a process of discovery

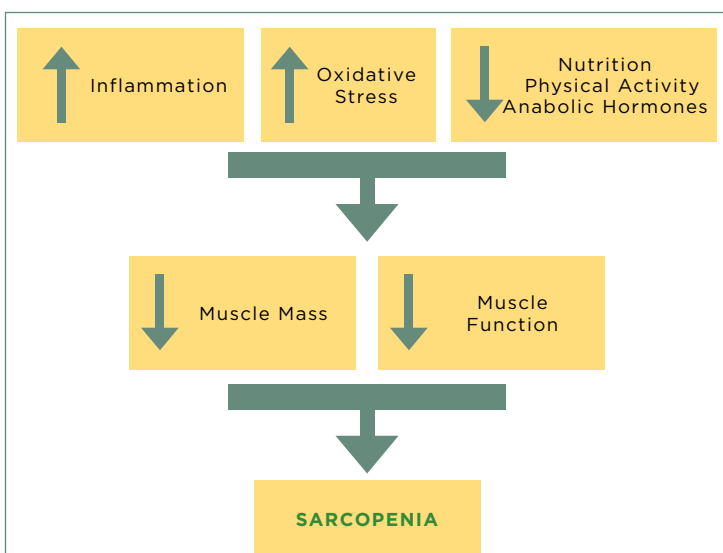
as to the efficacy of ‘meal-like’ quantities of dietary proteins to stimulate post-prandial muscle protein synthesis and effect a change in lean tissue mass in the elderly<sup>14,15</sup>.

Muscle is the predominant lean tissue. Central to a dietary approach to the preservation and/or accrual of lean tissue mass is the post-prandial capacity of dietary protein to stimulate muscle protein synthesis (MPS) and reduce muscle breakdown. Following ingestion of a protein meal MPS is increased for a period of up to three hours before declining to basal level (**Figure 2**). The magnitude of increase in MPS in the post-prandial period depends on the quantity and type of protein ingested. As non-essential amino acids do not invoke a change in MPS, proteins with a high relative composition of essential amino acids (EAA), such as milk proteins, are more potent. To highlight this effect, it has been reported in studies investigating muscle maintenance or accretion after resistance exercise, that the ingestion of whey protein and bovine milk promote a greater increase in MPS than consumption of an equivalent amount of plant-based soy protein<sup>16</sup>, despite the fact that these protein sources have protein digestibility-corrected amino acid scores (PDCAAS) above 1.0. The mechanism responsible for these differences is not entirely clear but probably relate to ‘quality’ of protein, normally attributed to the amino acid profile, and its bioavailability, encompassed by the kinetics of digestion, absorption and presentation to the target tissue.

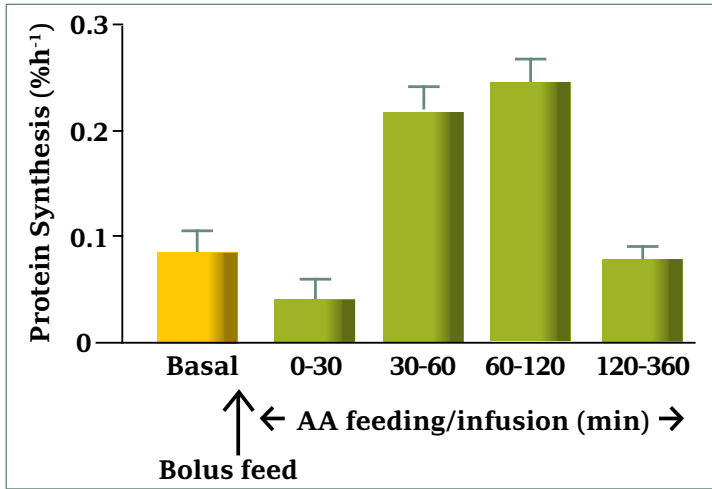
### Potential Advantage of Dairy Protein

As outlined above, the amino acid composition - specifically the high relative composition of EAAs - of dairy protein confers a potential advantage as a post-prandial stimulus to MPS compared to other common dietary protein sources. The Institute of Medicine’s recommended EAA intake approximates to 15g of EAAs/day for an ‘average’ 70kg person, which is satisfied by the ingestion of ~30g of milk protein. Other protein sources within the diet require a higher total protein intake (**Table 1**). Among the essential amino acids, the branched chain amino acids and especially leucine, are potent stimulants of MPS. The ability of leucine to influence MPS can be part explained by the fact that leucine acts as a substrate for, and regulator of, MPS. Leucine regulates MPS by activation of mTOR (mammalian target of rapamycin), an intracellular protein kinase and transcriptional regulator of protein synthesis<sup>17–19</sup> in a dose-dependent manner, leading to a proposal that a post-prandial ‘leucine threshold’ must be surpassed to optimally stimulate MPS<sup>15</sup>. Aging muscle is less sensitive to the normal post-prandial stimulatory effects of protein ingestion on MPS. This may, in part, be explained by a higher leucine threshold to elicit the same anabolic response<sup>20,21</sup>. Addition of leucine to a mixed nutrient meal restores the post-prandial stimulation of MPS in the elderly<sup>21</sup>.

Accumulating evidence suggest that the bioavailability and



▲ Figure 1. Factors contributing to sarcopenia



▲ Figure 2. Post-prandial effects on MPS

bioactivity of milk protein could act to overcome the post-prandial ‘anabolic resistance’ in the elderly. Ingestion of whey protein evokes a rapid increase in post-prandial amino acid availability<sup>22</sup>. It appears the faster digestion and absorption kinetics of whey allows for a greater increase in post-prandial plasma amino acid availability and a greater stimulation of MPS in the elderly<sup>23</sup>.

**Summary Conclusion**

Current debate centres on whether older people require more protein than younger adults and, thereby, should ingest more than the current RDA. The benefit of increasing dietary protein intakes above the current RDA in the elderly on muscle mass and muscle function is, as yet, equivocal. Consensus opinion indicates that a *quantitative* and *qualitative* modification of dietary protein intake may be necessary to counteract progressive lean tissue (muscle) loss in the elderly. Based on recent evidence habitual dietary protein intake should be optimised to promote MPS. Because of the high relative EAA and, specifically, leucine composition in dairy protein, greater emphasis on dairy protein in the elderly is warranted.

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EAA	IOM		Milk Whey			Milk Casein			Wheat Grain			Soy Protein		
	mg/kg/d	g/d	g/100	g*	%IOM	g/100	g*	%IOM	g/100	g*	%IOM	g/100	g*	%IOM
His	14	0.98	2.1	0.62	63%	3.1	0.99	101%	2.3	1.04	107%	2.8	1.05	107%
Iso	19	1.33	7.2	2.12	160%	4.9	1.57	118%	3.7	1.68	126%	4.4	1.65	124%
Leu	42	2.94	11.2	3.30	112%	9.9	3.16	108%	6.8	3.09	105%	6.2	2.32	79%
Lys	38	2.66	8.8	2.59	98%	7.9	2.52	95%	2.8	1.27	48%	6.2	2.32	87%
Meth+Cyst	19	1.33	2.2	0.65	49%	3.1	0.99	74%	3.5	1.59	119%	2	0.75	56%
Phe+Tyr	33	2.31	3.1	0.91	40%	5.9	1.88	82%	6.4	2.90	126%	8.8	3.30	143%
Thre	20	1.4	8	2.36	169%	3.8	1.21	87%	2.9	1.32	94%	3.2	1.20	86%
Try	5	0.35	1.9	0.56	160%	1.5	0.48	137%	0.21	0.10	27%	1	0.37	107%
Val	24	1.68	6.3	1.86	111%	6.8	2.17	129%	4.4	2.00	119%	5.4	2.02	120%
Total	214	14.98	50.8	14.98	107%	46.9	14.98	103%	33.01	14.98	97%	40	14.98	101%
Protein(g)				29.49			31.94			45.38			37.45	

▲ Table 1. Institute of Medicine (IOM) guideline recommended daily intake of essential amino acids (EAA) and the relative EAA composition of whey, casein, wheat grain and soy proteins. Data for average 70kg body mass.

\*g refers to the amount of each protein source in grams that would need to be consumed to meet the IOM recommendation of 14.98g for EAAs. E.g. to consume 14.98g of EAAs the total amount of whey, casein, wheat and soy protein that would need to be consumed are 29.49g, 31.94g, 45.38g, 37.45g respectively.

## Dairy Protein and Muscle Mass in the Elderly: Key Points

- Sarcopenia is the term given to the progressive decline in lean tissue (muscle) mass that occurs in aging, and when sarcopenic losses reduce skeletal muscle mass below a critical threshold, significant implications may result, such as disability and comprised ability to perform daily activities.
- Sarcopenia has been described as multifactorial, with many factors to be considered regarding the management of this syndrome. From a nutritional perspective, the role of dietary protein is among the factors currently being evaluated. Quantity, amino acid composition and distribution of protein intake in the daily diet are issues currently being debated regarding the preservation of lean tissue mass in aging.
- Research is supporting possible advantages of milk protein with regard to muscle protein synthesis in the elderly. Essential amino acid content (especially leucine) and bioavailability are both thought to play a role in such benefits.
- Considering the unprecedented projections regarding population aging, developments aimed at healthy and successful aging are most welcome. Potential benefits of dairy protein in muscle protein synthesis in the elderly warrant further evaluation, with a view to pursuing scientifically substantiated, dairy-based functional foods and ingredients.

## INDI / NDC Symposium

The National Dairy Council is delighted to become a Corporate Partner of the Irish Nutrition and Dietetic Institute (INDI). Richelle Flanagan, President of the INDI, welcomed the NDC, saying: "The INDI are delighted to welcome the National Dairy Council as a new Corporate Partner. It is a logical collaboration for both organisations as dairy foods play a huge role across the life-cycle. We look forward to working together with the NDC over the coming year, beginning with a very topical symposium looking at body weight and composition from children through to older people."

### INDI / NDC Symposium

#### Body Weight and Body Composition Throughout the Life-Cycle

Tuesday 30th April 2013

Keynote speaker: Dr. Marta Van Loan

Break-out sessions: For a further in-depth facilitated discussion on this topic, choose your area of interest - Paediatrics, Adult, the Older Person.

Further details will be announced shortly: [www.ndc.ie](http://www.ndc.ie) / [www.indi.ie](http://www.indi.ie)

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**Mission:** To leverage the world class capabilities of the Irish academic partners, with the market expertise of the industry partners, into a pipeline of innovative, nutritional functional ingredients/products for the global food industry.