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Plasma albumin redox state is superior to conventional biomarkers to indicate the presence of potential protein undernutrition

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Abstract
The redox state of plasma albumin would reflect albumin synthesis rate, and could be useful to demonstrate the presence of potential protein undernutrition. Aiming to delineate the characteristics of plasma albumin redox state as a nutritional biomarker, adult male Wistar rats were maintained on AIN-93M (14% casein, control diet) or an AIN-93M-based low protein diet (5% casein) *ad libitum* for 4 weeks, and the two groups were compared by examining plasma albumin redox state, plasma/serum levels of conventional biomarkers for protein nutritional status, and plasma proteome. While no significant difference was seen in body weight at the end of the experimental period, plantaris muscle mass trended lower in the low protein diet group, implicating the manifestation of moderate protein undernutrition. The redox of plasma albumin was shifted to more oxidized state in the low protein diet group, and the shift persisted during the entire experimental period. In contrast, the levels of conventional biomarkers, plasma albumin and prealbumin, were initially decreased in the low protein diet group, and the differences were then dissolved later in the experimental period. Similarly, the levels of other biomarkers, plasma transferrin and serum retinol-binding protein-4, did not differ significantly at the end of the experimental period. Plasma proteomic analysis revealed that the abundances of proteins that constitute high-density lipoprotein (HDL), apolipoprotein A-II and paraoxonase-1, were decreased in the low protein diet group, which were then validated by confirming decreases in plasma HDL level, plasma HDL-cholesterol level, and serum paraoxonase-1 activity in the low protein diet group. According to epidemiological reports, dietary protein intake is positively associated with plasma HDL-cholesterol level, and the risk factors of cardiovascular diseases, including lower HDL-cholesterol level, are closely related to frailty. Thus, it can be conceived that moderate dietary protein insufficiency would increase cardiovascular risks, such as reduction in HDL level and function (paraoxonase-1 activity), which could prime the onset of amyotropic diseases later in life, such as sarcopenia and frailty. Collectively, moderate dietary protein insufficiency would lead to decreased skeletal muscle mass, and also attenuate circulating HDL level and function, which could even aggravate the attenuation of skeletal muscle accretion; the redox state of plasma albumin would be instrumental over conventional biomarkers as an indicator of potentially protein undernourished status.

Conflict of Interest
All the authors are employees of Morinaga Milk Industry Co., Ltd.