

Effect of Aging on the Second Law Efficiency, Exergy Destruction and Entropy Generation in the Skeletal Muscles during Exercise

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Abstract : The second law muscle work efficiency is obtained by multiplying the metabolic and mechanical work efficiencies. Thermodynamic analyses are carried out with 19 sets of arms and legs exercise data which were obtained from the healthy young people. These data are used to simulate the changes occurring during aging. The muscle work efficiency decreases with aging as a result of the reduction of the metabolic energy generation in the mitochondria. The reduction of the mitochondrial energy efficiency makes it difficult to carry out the maintenance of the muscle tissue, which in turn causes a decline of the muscle work efficiency. When the muscle attempts to produce more work, entropy generation and exergy destruction increase. Increasing exergy destruction may be regarded as the result of the deterioration of the muscles. When the exergetic efficiency is 0.42, exergy destruction becomes 1.49 folds of the work performance. This proportionality becomes 2.50 and 5.21 folds when the exergetic efficiency decreases to 0.30 and 0.17 respectively.

Keywords : aging mitochondria, entropy generation, exergy destruction, muscle work performance, second law efficiency

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