

Prof. Yoshinori Ohsumi's laboratory at NIBB: Fermentation of yeast cell autophagy research

NIBB Professor Emeritus Yoshinori Ohsumi won the Nobel Prize in Physiology or Medicine for 2016 for his discoveries of the mechanisms for autophagy[¶]. Dr. Ohsumi presided over the Division of Molecular Cell Biology at NIBB for 13 years, from 1996 to 2009. It is a great honor for me, as an alumnus of his laboratory, to introduce to you a brief summary of the fruitful progress of Dr. Ohsumi's work.

In April 1996, Dr. Ohsumi came to NIBB from the University of Tokyo, with 13 yeast "apg" mutants, which have defects in autophagy*. At NIBB he made many advancements with his colleagues to investigate the molecular mechanisms of autophagy: cloning of yeast *ATG* genes, screening of additional *ATG* genes, biochemical and cell biological characterization of Atg proteins, and extensive autophagy studies in higher eukaryotes.

The main research achievements of Dr. Ohsumi's Laboratory are as follows:

Firstly, 18 Atg proteins were classified into 5 subgroups on the basis of biochemical analyses:

- (1) Atg1 kinase and its regulators¹, recognizing nutrient starvation, an inducing signal of autophagy;
- (2) Phosphatidylinositol 3-kinase complex², generating phosphatidylinositol 3-phosphate (PI-3P), an important material for autophagosome;
- (3) Atg12 conjugation system³;
- (4) Atg8 conjugation system⁴, both of which are ubiquitin-related systems, revealing that two intracellular protein degradation process, autophagy and ubiquitin-proteasome, employ a similar molecular device;
- (5) Atg2-Atg18 complex and Atg9⁵, PI-3P binding proteins and a membrane-integrating protein, respectively.

Secondly, fluorescence microscopy studies revealed that these Atg proteins hierarchically assemble together at "PAS" (pre-autophagosomal structure) to generate autophagosome⁶. Through these yeast studies, they established a schematic molecular model of autophagy⁷. And lastly they found that these findings derived from yeast studies are fundamentally conserved among another eukaryotes, especially mammals⁸ and plants⁹, to create a universal field of study of autophagy, an important protein degradation system.

(Yoshiaki Kamada)

References

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¶ https://www.nobelprize.org/nobel_prizes/medicine/laureates/2016/

* Autophagy-related genes including "APG" genes were uniformly renamed as "ATG" genes in 2003.

† These two papers are selected as 'Key Publications' by the Nobel Committee.



Dr. Ohsumi's 60th birthday party (2005).



Dr. Ohsumi and Dr. Ohsumi's Lab members with Dr. Aaron Ciechanover, a ubiquitin researcher and a Nobel Laureate (2006).



Dr. Ohsumi and Dr. Ohsumi's Lab members posing "Ina Bauer" (2006).



Executive members of the NINS and NIBB staff gathering at the unveiling ceremony (2017).



Dr. Ohsumi visited NIBB for the unveiling ceremony of the Nobel prize monument, inspired by an image of the budding yeast (2017).