

White, brown and pink adipocytes are able to undergo physiologic and reversible transdifferentiation

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Adipocytes are the parenchymal cells of the adipose organ and that are defined by their relevant cytoplasmic content of triglycerides. We observed that in physiologic conditions three different types of adipocytes could be found in the organ: white, brown and pink. White adipocytes are unilocular and their function is related to energy storage. Brown adipocytes are multilocular and through their special and unique mitochondria produce heat dissipating energy. The third type of adipocytes appears only in subcutaneous depots (mammary glands) of females during pregnancy and lactation and is responsible for milk production for lactation. The parenchymal composition of the adipose organ can vary to satisfy different needs of the organism. During chronic cold exposure brown adipocytes can be the prevalent cell type. During warm exposure or high fat diet white adipocytes can be prevalent and during pregnancy and lactation pink cells are the prevalent cell type. We propose the adjective pink because pregnant and lactating mammary gland are pink and because of the gender relationship. Pink adipocytes are organized to form lobulo-alveoli that secrete milk into mammary ducts ending in nipples. Lipid droplets in pink adipocytes are the predominant organelle during the last period of pregnancy, but classic milk-protein granules can be also detected in their cytoplasm. Electron microscopy, at late pregnancy, shows several intermediate stages between white and pink adipocytes. Of note, perilipin 2 substitute for perilipin 1 at the lipid droplet surface when pink adipocytes are organized in glands. Pink adipocytes showing both proteins in serial sections were rarely found. Lineage tracing (1) and explants (2) experiments showed that pink adipocytes derive from direct and reversible conversion of white adipocytes. White adipocytes are also able to reciprocally transform into brown adipocytes outlining the extraordinary plastic property of the adipose organ.

References

- [1] Morrioni et al. (2004) Reversible transdifferentiation of secretory epithelial cells into adipocytes in the mammary gland. PNAS 101: 16801-6.
- [2] De Matteis et al. (2009) In vivo physiological transdifferentiation of adult adipose cells. Stem Cells 27: 2761-8.

Key words

Adipose organ, white adipocytes, brown adipocytes, pink adipocytes, mammary gland, transdifferentiation, electron microscopy, immunohistochemistry.