CLAIMS

What is claimed is:

1. Use of [3-^{13}C]acetoacetate as an imaging agent for *in vitro* or *ex vivo* diagnosis of cancer, diabetes, cardiovascular disease, or neurodegenerative disease, wherein at least 10% of said [3-^{13}C]acetoacetate is hyperpolarized.

2. Use of a composition comprising [3-^{13}C]acetoacetate as an imaging agent for *in vitro* or *ex vivo* diagnosis of cancer, diabetes, cardiovascular disease, or neurodegenerative disease, wherein at least 10% of said [3-^{13}C]acetoacetate is hyperpolarized.

3. Method of preparing [3-^{13}C]acetoacetate or a composition comprising [3-^{13}C]acetoacetate, wherein at least 10% of said [3-^{13}C]acetoacetate is hyperpolarized, wherein the method comprises the steps of :
(a) chemically synthesizing [3-^{13}C]acetoacetate or a composition comprising [3-^{13}C]acetoacetate; and
(b) hyperpolarizing said [3-^{13}C]acetoacetate or said composition from step (a) with microwave irradiation at 94.097 GHz.

4. The method of claim 3, wherein [3-^{13}C]acetoacetate is prepared from [3-^{13}C]ethyl acetoacetate.

5. The method of claim 4, wherein the chemical synthesis of [3-^{13}C]acetoacetate involves the saponification of [3-^{13}C]ethyl acetoacetate.

6. The method of any one of claims 3-5, wherein the chemical synthesis of [3-^{13}C]acetoacetate comprises reacting [3-^{13}C]ethyl acetoacetate and a base, preferably an alkali hydroxide, more preferably lithium hydroxide, under conditions allowing said reaction.

7. The method of any one of claims 3-6, wherein the synthesized [3-^{13}C]acetoacetate is hyperpolarized using Dynamic Nuclear Polarization (DNP).

8. An *in vitro* or *ex vivo* method of determining the spatial and temporal distribution and metabolism of [3-^{13}C]acetoacetate and/or its metabolites in a cell to diagnose cancer, diabetes, cardiovascular disease, or neurodegenerative disease, wherein the method comprises the steps of:

(a) administering [3-^{13}C]acetoacetate or a composition comprising [3-^{13}C]acetoacetate to the cell, wherein at least 10% of said [3-^{13}C]acetoacetate is hyperpolarized; and
(b) determining the distribution and metabolism of hyperpolarized [3-^{13}C]acetoacetate and/or its metabolites in the cell by magnetic resonance imaging (MRI), magnetic resonance spectroscopy (MRS), and/or magnetic resonance spectroscopic imaging (MRSI).

9. The method of claim 8, wherein the cell is a cell culture or an ex vivo tissue.

10. The method of claim 8 or 9, wherein the metabolites of [3-^{13}C]acetoacetate are selected from the group consisting of [5-^{13}C]glutamate, [1-^{13}C]citrate, [1-^{13}C]acetylcarnitine, and [3-^{13}C]beta-hydroxybutyrate.

11. The method of any one of claims 8-10, wherein the magnetic resonance signals from hyperpolarized [3-^{13}C]acetoacetate and its metabolites are used to study the in vivo metabolism of acetoacetate and/or other ketone bodies.

12. The method of any one of claims 8-11, wherein the magnetic resonance signals from hyperpolarized [3-^{13}C]acetoacetate and its metabolites are used to quantify specific physiological functions of the cell in healthy (e.g. starvation) and/or diseased conditions, wherein the diseased conditions comprise cancer, diabetes, cardiovascular disease, or neurodegenerative disease.