CLAIMS

The invention is claimed as follows:

1. A method of minimizing changes in finished product temperature during aseptic sterilization processes, the method comprising:
applying an energy balance feedforward control scheme to an aseptic sterilization process;
characterised in that the energy balance feedforward control scheme comprises:

an additive feedforward controller including the input variables product density, heat capacity of the product and information from the flow indication;

a heat source adjustment calculated from a first principles energy balance on a heater combined with an adjustment calculated by feedback temperature control.

2. The method according to Claim 1, wherein the finished product is a baby food product.

3. The method according to any one of Claims 1-2, wherein the finished product is a non-homogenous food product.

~~4. The method according to any one of Claims 1-3, wherein the energy balance feedforward control scheme comprises an additive feedforward controller.~~

~~5~~4. The method according to ~~Claim 4~~any one of Claims 1-3, wherein the additive feedforward controller calculates steam demand from energy balance.

~~6~~5. The method according to ~~Claim 4~~any one of Claims 1-3, wherein the additive feedforward controller calculates coolant demand from energy balance.

~~7~~6. The method according to any one of Claims 1-~~6~~5, wherein the energy balance feedforward control scheme comprises a temperature indicating controller that provides feedback trim.

~~8~~7. The method according to any one of Claims 1-~~7~~6, wherein the energy balance feedforward control scheme comprises a heat indicating controller.

~~9~~8. The method according to any one of Claims 1-~~8~~7, wherein the energy balance feedforward control scheme comprises flow indication.

~~10~~9. The method according to any one of Claims 1-~~9~~8, wherein the energy balance feedforward control scheme comprises temperature indication.

~~11~~10. The method according to any one of Claims 1-~~10~~9, wherein the energy balance feedforward control scheme is applied to a heating component of the aseptic sterilization process.

~~12. The method according to any one of Claims 1-11, wherein the energy balance feedforward control scheme comprises a heat source adjustment calculated from a first principles energy balance on a heater combined with an adjustment calculated by feedback temperature control.~~

~~13~~11. The method according to any one of Claims 1-~~12~~10, wherein the energy balance feedforward control scheme is applied to a cooling component of the aseptic sterilization process.

~~14~~12. The method according to any one of Claims 1-~~13~~11, wherein the energy balance feedforward control scheme comprises a coolant source adjustment calculated from a first principles energy balance on a coolant combined with an adjustment calculated by feedback temperature control.

~~15~~13. The method according to any one of Claims 1-~~14~~12, wherein the energy balance feedforward control scheme causes a feedforward correction to reach the finished product at the same time as a disturbance through dynamic adjustment of at least one input variable.

~~16~~14. The method according to Claim ~~15~~13, wherein the ~~at least one~~ input variable~~s~~ ~~is~~are ~~selected from the group consisting of~~ density of the product, product flow rate, heat capacity of the product~~,~~ and temperature of the product~~, and combinations thereof~~.

~~17~~15. The method according to any one of Claims 1-~~16~~14, wherein the impact to a finished product of variations in an aseptic processing system is reduced.

~~18~~16. A method of aseptic product production, the method comprising:
preparation of raw ingredients in batch tanks;
deposition of batches of the ingredients into an aseptic sterilization process;
passing the ingredients through a sterilizing heater; and
minimizing changes in finished product temperature during aseptic sterilization processes by regulating temperature differences between batches using an energy balance feedforward control scheme;
wherein the minimizing changes in finished product temperature during aseptic sterilization processes is selected from the group of methods consisting of those claimed in any one of Claim 1 to Claim 15.

~~19. The method according to Claim 28, wherein the minimizing changes in finished product temperature during aseptic sterilization processes is selected from the group of methods consisting of those claimed in any one of Claims 1 to Claim 17.~~

~~20~~17. A food manufacturing system comprising:
a product supply;
a process for minimizing changes in finished product temperature during aseptic sterilization process comprising a heat source and a sterilizing heater;
and
an energy balance feedforward control scheme that is applied to the aseptic sterilization process;
and
a controller adapted to carry out the method of any of Claims 1 to 15.

~~21. The system according to Claim 20, wherein the minimizing changes in finished product temperature during aseptic sterilization processes is selected from the group of methods consisting of those claimed in any one of Claims 1 to Claim 17~~