CLAIMS

1. A method for locating and selecting a colony of microorganisms on a culture dish and identifying microorganisms in said selected colony using Matrix Assisted Laser Desorption and Ionization (MALDI), wherein said method comprises the automated steps of:

- locating and selecting a colony of microorganisms on a culture dish;
- obtaining a sample of said selected colony of microorganisms;
- depositing at least some of said sample of said selected colony of microorganisms on a target plate;
- overlaying a drop of a MALDI matrix solution on said drop of sample suspension deposited on the target plate; and
- transferring said target plate with said sample in an apparatus for performing MALDI for identification of said sample of said selected colony of microorganisms

wherein the step of depositing at least some of said sample of said selected colony of microorganisms on a target plate is performed by the automated steps of:

- transferring said obtained sample into a suspension tube containing an amount of a suspension medium;
- preparing a sample suspension by transferring at least a portion of said obtained sample into said suspension medium;
- obtaining a drop of said sample suspension; and
- transferring said drop of sample suspension onto said target plate

wherein the method further comprises the automated steps of:

- obtaining a second drop of said sample suspension;
- depositing said second drop of sample suspension on a test culture dish; and
- transferring said test culture dish to an apparatus for performing a susceptibility test or another additional analysis.

2. A method according to claim 1, wherein the step of depositing at least some of said sample of said selected colony of microorganisms on a target plate is performed by directly placing said obtained sample of said selected colony of microorganisms on said target plate.

3. A method according to claim 1, wherein said drop of sample suspension deposited on the target plate is allowed to dry before said drop of MALDI matrix solution is overlaid.

4. A method according to claim 1, wherein in case the processing instructions for a selected colony of microorganisms indicate to prepare a suspension of a sample of said colony of microorganisms, the method comprises the step of automatic preparing a suspension of a sample of microorganisms comprising the automated steps of:

- providing a first picking tool and providing a positioning device with a picking tool holder for holding a picking tool, said positioning device being arranged for positioning a picking tool in a starting position above the obtained location of the selected colony of microorganisms on the culture dish and for automatically lowering and raising a picking tool towards and away from the culture dish and for positioning a picking tool in a transfer position, respectively;

- positioning said first picking tool in said picking tool holder of the positioning device;

- by said positioning device positioning the first picking tool in the starting position above the obtained location of the selected colony of microorganisms on the culture dish, automatically lowering the first picking tool towards the culture dish into contact with the microorganism to pick up a sample of said microorganism, automatically raising the first picking tool with said sample of the microorganism away from the culture dish to the transfer position;

- providing a suspension tube holder for holding a suspension tube;

- positioning a suspension tube in the suspension tube holder;

- providing an automatic suspension medium dispenser for automatically dispensing a suspension medium in a suspension tube held in the suspension tube holder;

- by the automatic dispenser automatically supplying an initial amount of suspension medium into the suspension tube held in the suspension tube holder;

- providing a transferring device for automatically transferring a picking tool from the transfer position of the positioning device to a position above a suspension tube held in the suspension tube holder, and for lowering and raising a picking tool into and away from a suspension medium contained in a suspension tube, and for positioning a

picking tool in a waiting position above a suspension tube held in the suspension tube holder, respectively;

- by said transferring device automatically transferring said first picking tool with the sample of the microorganism from the transfer position of the positioning device to a position above the suspension tube held in the suspension tube holder, lowering said first picking tool with the sample of the microorganism into the suspension medium contained in the suspension tube; by the transferring device oscillating the first picking tool in a linear vertical movement for a period of time while the first picking tool with the sample of said microorganism is submerged in the suspension medium; and after said period of time has elapsed raising the first picking tool away from the suspension medium contained in the suspension tube to the waiting position;

- providing a turbidity meter for performing measurements of the turbidity of a suspension medium contained in a suspension tube held in the suspension tube holder;

- at least after the period of time during which the picking tool is oscillated has elapsed measuring the turbidity of the suspension medium contained in the suspension tube held in the suspension tube holder by the turbidity meter and providing a final measurement value indicative of the measured turbidity;

- providing a controller communicatively connected to the positioning device, the transferring device, the automatic suspension medium dispenser and the turbidity meter for automatically controlling the movement of the positioning device, the movement of the transferring device, the operation of the automatic suspension medium dispenser and the operation of the turbidity meter, respectively;

- wherein said controller:

a) compares the final measurement value to a first threshold value previously stored in a memory of the controller, and, if above, causes the automatic suspension medium dispenser to supply an additional amount of suspension medium into the suspension tube; and, if identical to or below the first threshold value and identical to or above a second threshold value previously stored in the memory of the controller, said first threshold value being equal to or greater than the second threshold value provide a signal that the suspension tube with the suspension can be removed from the suspension tube holder for further processing.

5. A method according to claim 1, wherein the method comprises providing an automatic culture dish positioning and removing device for automatically positioning and removing a culture dish comprising said microorganism on and from the stage, respectively, the step of arranging the controller such that it is communicatively connected to the automatic culture dish positioning and removing device for controlling the operation of the automatic culture dish positioning and removing device, wherein the step of positioning a culture dish comprising said microorganism on the stage is performed automatically under control of the controller.

6. A method according to claim 5, wherein the controller is arranged such that a culture dish is allowed to be automatically removed from the stage by the automatic culture dish positioning and removing device only after the signal that the suspension tube with the suspension can be removed from the suspension tube holder for further processing has been provided.

7. A method according to claim 4, wherein the method comprises providing an automatic suspension tube positioning and removing device for automatically positioning and removing a suspension tube in and from the suspension tube holder, respectively, the step of arranging the controller such that it is communicatively connected to the automatic suspension tube positioning and removing device for controlling the operation of the automatic suspension tube positioning and removing device, wherein the step of positioning a suspension tube in the suspension tube holder is performed automatically under control of the controller.

8. A method according to claim 7, wherein the controller is arranged such that a suspension tube holder is automatically removed from the suspension tube holder by the automatic suspension tube positioning and removing device only after the signal that the suspension tube with the suspension can be removed from the suspension tube holder for further processing has been provided.

9. A method according to claim 4, wherein the method comprises the step of providing an identifying mark on the suspension tube, and the step of storing the identifying mark of said suspension tube together with the properties of the suspension

with a link to the identity of the culture dish from which the selected colony of microorganisms was obtained in the memory of said central control computer.

10. A method according to claim 2, wherein in case the processing instructions for a selected colony of microorganisms indicate to directly place said obtained sample of said selected colony of microorganisms on said target plate, the method comprises the following automated steps:

- providing a first picking tool and providing a positioning device with a picking tool holder for holding a picking tool, said positioning device being arranged for positioning a picking tool in a starting position above the obtained location of the selected colony of microorganisms on the culture dish and for automatically lowering and raising a picking tool towards and away from the culture dish and for positioning a picking tool in a transfer position, respectively;

- positioning said first picking tool in said picking tool holder of the positioning device;

- by said positioning device positioning the first picking tool in the starting position above the obtained location of the selected colony of microorganisms on the culture dish, automatically lowering the first picking tool towards the culture dish into contact with the microorganism to pick up a sample of said microorganism, automatically raising the first picking tool with said sample of the microorganism away from the culture dish to the transfer position;

- providing a target plate holder for holding a target plate, said target plate having a plurality of depositing spots;

- positioning a target plate in the target plate holder;

- providing a transferring device for automatically transferring the picking tool from the transfer position of the positioning device to a position above one of the depositing spots of the target plate, and for lowering the picking tool such that the sample of the colony of microorganisms present on the picking tool comes into contact with the target plate, moving the picking tool in a plane parallel to the plane of the target plate such that the sample of the colony of microorganisms is deposited on the depositing spot, in particular covering at most approximately half of said one of the depositing spots of the target plate; and

- raising said picking tool from the target plate.

11. A method according to claim 10, wherein the method comprises the step of providing an identifying mark on the target plate and optionally providing an identifying mark on the depositing spots of said target plate, and the step of storing the identifying mark of said target plate and depositing spots together with the properties of the suspension with a link to the identity of the culture dish from which the selected colony of microorganisms was obtained in the memory of said central control computer.

12. A method for automatic preparing a suspension of a sample of microorganisms according to claim 1, wherein the method comprises providing an automatic suspension tube positioning and removing device for automatically positioning and removing a suspension tube in and from the suspension tube holder, respectively, the step of arranging the controller such that it is communicatively connected to the automatic suspension tube positioning and removing device for controlling the operation of the automatic suspension tube positioning and removing device, wherein the step of positioning a suspension tube in the suspension tube holder is performed automatically under control of the controller.

13. A method for automatic preparing a suspension of a sample of microorganisms according to claim 12, wherein the controller is arranged such that a suspension tube holder is automatically removed from the suspension tube holder by the automatic suspension tube positioning and removing device only after the signal that the suspension tube with the suspension can be removed from the suspension tube holder for further processing has been provided.

14. An apparatus for automatic preparation of a suspension of a sample of microorganisms for performing a method or a step of a method for automatic preparing a suspension of a sample of microorganisms according to claim 1, said apparatus comprising:

- a stage for a culture dish comprising said microorganism;
- a first and a further picking tool and a positioning device with a picking tool holder for holding a picking tool, said positioning device being arranged for positioning a picking tool in a starting position above the culture dish and for automatically lowering and raising a picking tool towards and away from the culture dish and for positioning a picking tool in a transfer position, respectively;

- a suspension tube holder for holding a suspension tube;

- an automatic suspension medium dispenser for automatically dispensing a suspension medium in a suspension tube held in the suspension tube holder;

- a transferring device for automatically transferring a picking tool from the transfer position of the positioning device to a position above a suspension tube held in the suspension tube holder, and for lowering and raising a picking tool into and away from a suspension medium contained in a suspension tube, and for positioning a picking tool in a waiting position above a suspension tube held in the suspension tube holder, respectively, said transferring device further being arranged for oscillating a picking tool in a linear vertical movement for a period of time;

- a turbidity meter for performing measurements of the turbidity of a suspension medium contained in a suspension tube held in the suspension tube holder and for providing a final measurement value indicative of the measured turbidity;

- a controller communicatively connected to the positioning device, the transferring device, the automatic suspension medium dispenser and the turbidity meter for automatically controlling the movement of the positioning device, the movement of the transferring device, the operation of the automatic suspension medium dispenser and the operation of the turbidity meter, respectively;

- said controller being arranged for:

a) determining whether the final measurement value is above a first threshold value previously stored in a memory of the controller, if yes said controller being arranged for performing step b); or whether the final measurement value is identical to or below the first threshold value and identical to or above a second threshold value previously stored in the memory of the controller, said first threshold value being equal to or greater than the second threshold value, if yes said controller being arranged for performing step c); or whether the final measurement value is below the second threshold value, if yes said controller being arranged for performing step d);

b) controlling the automatic suspension medium dispenser to supply an additional amount of suspension medium into the suspension tube;

c) providing a signal that the suspension tube with the suspension can be removed from the suspension tube holder for further processing; or

d) positioning said further picking tool in said picking tool holder of the positioning device; by said positioning device positioning the further picking tool in the starting position above the culture dish, automatically lowering the further picking

tool towards the culture dish into contact with the microorganism to pick up an additional sample of said microorganism, automatically raising the further picking tool with said sample of the microorganism away from the culture dish to the transfer position; by said transferring device automatically transferring said further picking tool with the additional sample of the microorganism from the transfer position of the positioning device to a position above the suspension tube held in the suspension tube holder, lowering said further picking tool with the additional sample of the microorganism into the suspension medium contained in the suspension tube thereby submerging the sample therein; and measuring the turbidity of the suspension medium contained in the suspension tube held in the suspension tube holder by the turbidity meter and providing an additional final measurement value indicative of the measured turbidity; and performing step a).

15. An apparatus for the automatic preparation of a suspension of a sample of microorganisms according to claim 14, wherein the controller is arranged for controlling the turbidity meter such that measuring the turbidity of the suspension medium contained in the suspension tube held in the suspension tube holder by the turbidity meter is started before the picking tool is submerged in the suspension medium contained in the suspension tube.

CLAIMS

1. A method for locating and selecting a colony of microorganisms on a culture dish and identifying microorganisms in said selected colony using Matrix Assisted Laser Desorption and Ionization (MALDI), wherein said method comprises the automated steps of:

- locating and selecting a colony of microorganisms on a culture dish;
- obtaining a sample of said selected colony of microorganisms;
- depositing at least some of said sample of said selected colony of microorganisms on a target plate;
- overlaying a drop of a MALDI matrix solution on said drop of sample suspension deposited on the target plate; and
- transferring said target plate with said sample in an apparatus for performing MALDI for identification of said sample of said selected colony of microorganisms,

wherein the step of depositing at least some of said sample of said selected colony of microorganisms on a target plate is performed by the automated steps of:

- transferring said obtained sample into a suspension tube containing an amount of a suspension medium;
- preparing a sample suspension by transferring at least a portion of said obtained sample into said suspension medium;
- providing a turbidity meter for performing measurements of turbidity of the suspension medium;
- measuring the turbidity of the suspension medium by the turbidity meter and providing a final measurement value indicative of the measured turbidity;
- obtaining a drop of said sample suspension; and
- transferring said drop of sample suspension onto said target plate, and

wherein the method further comprises the automated steps of:

- obtaining a second drop of said sample suspension;
- depositing said second drop of sample suspension on a test culture dish; and
- transferring said test culture dish to an apparatus for performing a susceptibility test or another additional analysis.

2. A method according to claim 1, wherein said drop of sample suspension deposited on the target plate is allowed to dry before said drop of MALDI matrix solution is overlaid.

3. A method according to claim 1, wherein the step of preparing the sample suspension of at least a portion of said selected colony of microorganisms comprising the automated steps of:

- providing a picking tool and providing a positioning device with a picking tool holder for holding the picking tool, said positioning device being arranged for positioning the picking tool in a starting position above the obtained location of the selected colony of microorganisms on the culture dish and for automatically lowering and raising the picking tool towards and away from the culture dish and for positioning the picking tool in a transfer position, respectively;

- positioning said picking tool in said picking tool holder of the positioning device;

- by said positioning device positioning the picking tool in the starting position above the obtained location of the selected colony of microorganisms on the culture dish, automatically lowering the picking tool towards the culture dish into contact with the microorganism to pick up a sample of said microorganism, automatically raising the picking tool with said sample of the microorganism away from the culture dish to the transfer position;

- providing a suspension tube holder for holding a suspension tube;

- positioning a suspension tube in the suspension tube holder;

- providing an automatic suspension medium dispenser for automatically dispensing a suspension medium in the suspension tube held in the suspension tube holder;

- by the automatic dispenser automatically supplying an initial amount of the suspension medium into the suspension tube held in the suspension tube holder;

- providing a transferring device for automatically transferring the picking tool from the transfer position of the positioning device to a position above the suspension tube held in the suspension tube holder, and for lowering and raising the picking tool into and away from the suspension medium contained in the suspension tube, and for positioning the picking tool in a waiting position above the suspension tube held in the suspension tube holder, respectively;

- by said transferring device automatically transferring said picking tool with the sample of the microorganism from the transfer position of the positioning device to a position above the suspension tube held in the suspension tube holder, lowering said picking tool with the sample of the microorganism into the suspension medium contained in the suspension tube; by the transferring device oscillating the picking tool in a linear vertical movement for a period of time while the picking tool with the sample of said microorganism is submerged in the suspension medium; and after said period of time has elapsed raising the picking tool away from the suspension medium contained in the suspension tube to the waiting position;

- wherein the turbidity meter measures the turbidity of a suspension medium contained in the suspension tube held in the suspension tube holder;

- at least after the period of time during which the picking tool is oscillated has elapsed measuring the turbidity of the suspension medium contained in the suspension tube held in the suspension tube holder by the turbidity meter and providing a final measurement value indicative of the measured turbidity;

- providing a controller communicatively connected to the positioning device, the transferring device, the automatic suspension medium dispenser and the turbidity meter for automatically controlling movement of the positioning device, movement of the transferring device, operation of the automatic suspension medium dispenser and operation of the turbidity meter, respectively;

- wherein said controller:

a) compares the final measurement value to a first threshold value and a second threshold value previously stored in a memory of the controller, said first threshold value being equal to or greater than the second threshold value, and,

if above the first threshold value, causes the automatic suspension medium dispenser to supply an additional amount of the suspension medium into the suspension tube;

if identical to or below the first threshold value and identical to or above a second threshold value previously stored in the memory of the controller, provides a signal that the suspension tube with the suspension can be removed from the suspension tube holder for further processing; and

if below the second threshold value, provides a further picking tool; positions said further picking tool in said picking tool holder of the positioning device; by said positioning device positioning the further picking tool in the starting position above the culture dish, automatically lowering the further picking tool towards the culture dish

into contact with the microorganism to pick up an additional sample of said microorganism, automatically raising the further picking tool with said sample of the microorganism away from the culture dish to the transfer position; by said transferring device automatically transferring said further picking tool with the additional sample of the microorganism from the transfer position of the positioning device to a position above the suspension tube held in the suspension tube holder, lowering said further picking tool with the additional sample of the microorganism into the suspension medium contained in the suspension tube; by the transferring device oscillating the further picking tool in a linear vertical movement for a period of time while the further picking tool with the additional sample of said microorganism is submerged in the suspension medium; and after said period of time has elapsed raising the further picking tool away from the suspension medium contained in the suspension tube to the waiting position; at least after the period of time during which the further picking tool is oscillated has elapsed measuring the turbidity of the suspension medium contained in the suspension tube held in the suspension tube holder by the turbidity meter and providing an additional final measurement value indicative of the measured turbidity; and performing step a).

4. A method according to claim 1, wherein the method comprises providing an automatic culture dish positioning and removing device for automatically positioning and removing the culture dish comprising said microorganism on and from a stage for the culture dish, respectively, arranging the controller such that it is communicatively connected to the automatic culture dish positioning and removing device for controlling the operation of the automatic culture dish positioning and removing device, wherein the step of positioning the culture dish comprising said microorganism on the stage is performed automatically under control of the controller.

5. A method according to claim 4, wherein the controller is arranged such that the culture dish is allowed to be automatically removed from the stage by the automatic culture dish positioning and removing device only after the signal that the suspension tube with the suspension can be removed from the suspension tube holder for further processing has been provided.

6. A method according to claim 3, wherein the method comprises providing an automatic suspension tube positioning and removing device for automatically

positioning and removing the suspension tube in and from the suspension tube holder, respectively, arranging the controller such that it is communicatively connected to the automatic suspension tube positioning and removing device for controlling the operation of the automatic suspension tube positioning and removing device, wherein the step of positioning the suspension tube in the suspension tube holder is performed automatically under control of the controller.

7. A method according to claim 6, wherein the controller is arranged such that the suspension tube holder is automatically removed from the suspension tube holder by the automatic suspension tube positioning and removing device only after the signal that the suspension tube with the suspension can be removed from the suspension tube holder for further processing has been provided.

8. A method according to claim 3, wherein the method comprises the step of providing an identifying mark on the suspension tube, and the step of storing the identifying mark of said suspension tube together with properties of the suspension with a link to the identity of the culture dish from which the selected colony of microorganisms was obtained in the memory of said central control computer.

9. A method for automatic preparing a suspension of a sample of microorganisms according to claim 1, wherein the method comprises providing an automatic suspension tube positioning and removing device for automatically positioning and removing a suspension tube in and from the suspension tube holder, respectively, arranging the controller such that it is communicatively connected to the automatic suspension tube positioning and removing device for controlling the operation of the automatic suspension tube positioning and removing device, wherein the step of positioning the suspension tube in the suspension tube holder is performed automatically under control of the controller.

10. A method for automatic preparing a suspension of a sample of microorganisms according to claim 9, wherein the controller is arranged such that a suspension tube holder is automatically removed from the suspension tube holder by the automatic suspension tube positioning and removing device only after the signal that the suspension tube with the suspension can be removed from the suspension tube holder for further processing has been provided.

11. An apparatus for automatic preparation of a suspension of a sample of microorganisms for performing a method or a step of a method for automatic preparing a suspension of a sample of microorganisms according to claim 1, said apparatus comprising:

- a stage for a culture dish comprising said microorganism;

- a picking tool and a positioning device with a picking tool holder for holding the picking tool, said positioning device being arranged for positioning the picking tool in a starting position above the culture dish and for automatically lowering and raising the picking tool towards and away from the culture dish and for positioning the picking tool in a transfer position, respectively;

- a suspension tube holder for holding the suspension tube;

- an automatic suspension medium dispenser for automatically dispensing a suspension medium in the suspension tube held in the suspension tube holder;

- a transferring device for automatically transferring the picking tool from the transfer position of the positioning device to a position above the suspension tube held in the suspension tube holder, and for lowering and raising the picking tool into and away from the suspension medium contained in the suspension tube, and for positioning the picking tool in a waiting position above the suspension tube held in the suspension tube holder, respectively, said transferring device further being arranged for oscillating the picking tool in a linear vertical movement for a period of time;

- a turbidity meter for performing measurements of turbidity of the suspension medium contained in the suspension tube held in the suspension tube holder and for providing a final measurement value indicative of the measured turbidity;

- a controller communicatively connected to the positioning device, the transferring device, the automatic suspension medium dispenser and the turbidity meter for automatically controlling movement of the positioning device, movement of the transferring device, operation of the automatic suspension medium dispenser and operation of the turbidity meter, respectively;

- said controller being arranged for:

a) determining whether the final measurement value is above a first threshold value previously stored in a memory of the controller, if yes said controller being arranged for performing step b); or whether the final measurement value is identical to or below the first threshold value and identical to or above a second threshold value previously stored in the memory of the controller, said first threshold

value being equal to or greater than the second threshold value, if yes said controller being arranged for performing step c); or whether the final measurement value is below the second threshold value, if yes said controller being arranged for performing step d);

b) controlling the automatic suspension medium dispenser to supply an additional amount of suspension medium into the suspension tube;

c) providing a signal that the suspension tube with the suspension can be removed from the suspension tube holder for further processing; or

d) positioning said further picking tool in said picking tool holder of the positioning device; by said positioning device positioning the further picking tool in the starting position above the culture dish, automatically lowering the further picking tool towards the culture dish into contact with the microorganism to pick up an additional sample of said microorganism, automatically raising the further picking tool with said sample of the microorganism away from the culture dish to the transfer position; by said transferring device automatically transferring said further picking tool with the additional sample of the microorganism from the transfer position of the positioning device to a position above the suspension tube held in the suspension tube holder, lowering said further picking tool with the additional sample of the microorganism into the suspension medium contained in the suspension tube thereby submerging the sample therein; and measuring the turbidity of the suspension medium contained in the suspension tube held in the suspension tube holder by the turbidity meter and providing an additional final measurement value indicative of the measured turbidity; and performing step a).

12. An apparatus for the automatic preparation of a suspension of a sample of microorganisms according to claim 11, wherein the controller is arranged for controlling the turbidity meter such that measuring the turbidity of the suspension medium contained in the suspension tube held in the suspension tube holder by the turbidity meter is started before the picking tool is submerged in the suspension medium contained in the suspension tube.