

PIERCING AND FLUID PROCESSING DEVICE

Field of the invention

The present invention relates to a device for piercing a pack comprising a beverage
5 ingredient, providing diluent inside the pack and dispensing a beverage from the pack.

Background of the invention

WO 2021/110650 and WO2023/006984 describe a machine for the preparation of a
beverage from a pack containing a beverage ingredient. The machine comprises a device to
10 open the pack, to introduce a diluent inside the pack and to dispense the beverage resulting
from the mixing of the diluent and the beverage ingredient. In addition, the device can
introduce air inside the flow of diluent before this flow enters the pack in order to create a
foamy beverage.

This device is useful to prepare beverages from soluble beverage ingredient powders like
15 soluble milk powder. Yet, it has been observed that the quality of the final dispensed
beverage is not always optimal; in particular, it has been observed that some lumps of
beverage powder can be dispensed from the pack inside the drinking cup meaning a non-
efficient dissolution. Inside the drinking cup, these lumps fall at the bottom of the beverage
cup and creates a difference of concentration between the top and the bottom of the cup (the
20 difference can reach up to 15 %). The aspect of the beverage is non appealing and the
expected taste is not obtained.

This effect appears to be linked to pellets leaking around the opening device and to a
sucking effect of the pellets due to an increase of pressure inside the pack during the
introduction of diluent.

25

An object of the invention is to address the above existing problem.

Summary of the invention

In a first aspect of the invention, there is provided a piercing and fluid processing device of a
30 beverage machine for producing a beverage from a pack, the pack comprises a beverage
ingredient configured to be mixed with a fluid to produce a beverage, the pack presenting a
plane shape oriented along a plane, and a bottom side of the pack being configured for
being openable,

the piercing and fluid processing device being for piercing the pack, for providing diluent
35 inside the pack to prepare a beverage by mixing said diluent with an ingredient contained in
said pack and for dispensing the beverage from the pack, said piercing and fluid processing
device comprising:

- a piercing end, and
- a diluent inlet conduit for introducing a diluent into said pack, and
- a beverage outlet conduit for dispensing the beverage from said pack, and

wherein a beverage inlet end of the beverage outlet conduit comprises multiple outlet holes.

5

This pack comprises a food or beverage ingredient able to produce a beverage further to mixing with an aqueous fluid, preferably water.

This food or beverage ingredient packed in the package is generally a water soluble powder that water dissolves such as instant coffee powder, milk powder, cream powder, instant tea
10 powder, cocoa powder, soup powder, fruit powder or mixture of said powders. The powders can be agglomerated or sintered. According to the preferred embodiment, the beverage ingredient is milk powder.

The pack presents a plane shape oriented along a plane (P) extending between a bottom side and an upper end.

15 An area of this bottom side is configured for being openable in order to introduce the aqueous fluid inside the pack and then to dispense the prepared beverage from the pack. Preferably, this area is configured for being openable by piercing, tearing, perforating or puncturing in particular by applying a pointed, tapered or sharp device, such as the fluid processing device, to said area. Preferably this openable area is positioned at the middle of
20 the transversal dimension of the longitudinal shape of the pack.

According to the invention, the inlet of the beverage outlet conduit of the piercing and fluid processing device comprises multiple outlet holes. The surface of the inlet of the beverage outlet conduit is covered by these multiple holes.

25 With these multiple holes covering the surface of the inlet of the beverage outlet conduit, this inlet of the beverage outlet conduit can be designed with a cross section that is sufficient to prevent the formation of overpressure followed by sucking effect inside the pack when the diluent is introduced: liquid can be introduced and evacuated without sucking effect. In addition, the multiple holes create a filtering function that prevents powder and lumps from
30 falling in the beverage conduit when the piercing and fluid processing device is piercing the openable part of the pack and when the beverage is being prepared.

In an embodiment, the smallest dimension of the multiple outlet holes is of at most 0.7 mm, preferably at most 0.6 mm, even more preferably at most 0.5 mm.

35 Such dimension prevents the fall of non-dissolved powder or lumps inside the large beverage outlet conduit below the multiple outlet holes.

The global surface defined by the multiple outlet holes can be of at least 25 mm², even more preferably at least 27 mm², for a flow of diluent entering the diluent inlet conduit comprised between 50 and 400 ml/min. Such a global surface avoids the building of pressure inside the pack and the effect that the pack starts inflating and deflating which affects the dissolution of powder and the smooth dispensing of the beverage.

- According to the preferred embodiment, the multiple outlet holes present the shape of slots, that is of long, narrow holes.
- 10 In an embodiment, the slots are designed in the inlet of the beverage outlet so that the longest dimension of a slot extends essentially along the longitudinal direction of the beverage conduit.
- These slots facilitate the production of a laminar flow, in particular by orienting the flow in the beverage outlet.
- 15 These slots can break the biggest bubbles produced inside the pack and enable the dispensing of a beverage comprising a very fine foam with very tiny bubbles size.

- In an embodiment, the multiple outlet holes are positioned as close as possible from the tip end of the piercing device. As a result, the global surface defined by the multiple outlet holes can be increased. In addition, with this embodiment, the direction of the flow of beverage can be oriented almost vertically.

- According to an embodiment, the cross area of the beverage outlet conduit decreases from its inlet surface, beverage inlet end, to its outlet surface, beverage outlet end. Accordingly, the speed of the dispensed beverage through the end of the outlet conduit can be increased.
- 25 In an embodiment, the smallest cross section of the beverage outlet conduit of the piercing and fluid processing device is of at least 8 mm², preferably at least 9 mm², for a flow of diluent entering the diluent inlet conduit comprised between 50 and 400 ml/min.
- Such a section avoids too the building of pressure inside the pack and the effect that the pack starts inflating and deflating which affects the dissolution of powder and the smooth dispensing of the beverage.
- 30

- In an embodiment, the length of the beverage outlet conduit of the piercing and fluid processing device is of at least 10 mm.
- 35

In an embodiment, the beverage outlet end of the beverage outlet conduit of the piercing and fluid processing device is connected to a downwardly oriented beverage guiding surface said beverage guiding surface decreasing up to a tip end.

5 This beverage guiding surface maintains the laminar flow of the beverage emerging from the end of the beverage outlet conduit.

It helps collecting and guiding the bubbles of the beverage to the drinking cup. Usually dispensing happens in an already prepared coffee, this guiding surface decreases the distance to the cup and limits splashing at the surface of the beverage.

10 In an embodiment, the downwardly oriented beverage guiding surface extends by at least 2 mm from the beverage outlet end.

In an embodiment, the diluent inlet conduit of the piercing and fluid processing device can comprise a local restricted section in order to produce and introduce a jet of diluent in the pack. This jet of diluent increases the mixing of the diluent with the beverage ingredient and
15 the dissolution of the beverage ingredient.

In order to create or improve the foaming of the beverage prepared from the pack, the piercing and fluid processing device can comprise an air inlet conduit. Preferably, the outlet end of said air inlet conduit emerges at the downstream side of the local restricted section of
20 the diluent inlet conduit.

Having air introduced at the inlet section reduction increases the sucking of air in the jet of diluent and improves the production of a foam presenting small bubble size.

This feature of the air inlet conduit is independent from the above features of the beverage outlet conduit.
25

In an embodiment, the piercing and fluid processing device is made of at least two dismountable upper and lower sub-parts, the upper part comprising at least the multiple outlet holes. This dismountable configuration enables an easier manufacture of the multiple outlet holes of the device, in particular by plastic injection moulding.

30 Preferably, the upper part can comprise the air inlet conduit when such a conduit is provided at the downstream side of the local restricted section of the diluent inlet conduit.

In a second aspect, there is provided a beverage preparation machine for producing a beverage from a pack, said pack comprises a beverage ingredient configured to be mixed
35 with a fluid to produce a beverage, said pack presenting a plane shape oriented along a plane, and the bottom side of said pack being configured for being openable, said beverage preparation machine comprising:

. a pack holding area adapted for receiving and holding a pack in the beverage preparation machine so that the plane (P) of the plane shape of the pack is oriented in an essentially vertical position, and

5 . a piercing and fluid processing device for piercing the pack, for providing diluent inside the pack to prepare of a beverage by mixing said fluid with an ingredient contained in said pack and for dispensing the beverage from the pack, said piercing and fluid processing device comprising:

- a piercing end, and

- a diluent inlet conduit for introducing a diluent into said pack, and

10 - a beverage outlet conduit for dispensing the beverage from said pack, and

. a diluent supply system connected to the diluent inlet conduit of the piercing and fluid processing device, and

. an actuator to transfer the piercing and fluid processing device:

- from a retracted position outside of the pack,

15 - to an operation position within the pack where the piercing end projects inside the pack and the diluent inlet conduit and beverage outlet conduit of the piercing and fluid processing device are oriented in an essentially vertical position,

wherein the beverage inlet end of the beverage outlet conduit of the piercing and fluid processing device comprises multiple outlet holes.

20

The machine comprises a pack holder area configured to hold the pack within the machine during the beverage preparation, a piercing and fluid processing device configured to introduce fluid in a pack that is present in the pack holder area and an actuator to move the fluid processing device and the pack hold in the machine one to the other.

25

Usually, this pack holder area comprises a pack chamber adapted for receiving a pack for a beverage preparation inside the module.

The pack chamber is configured for holding the pack in an essentially vertical position inside the module. This vertical position guarantees the efficient preparation of the beverage and particularly the dispensing of the beverage from the pack so that the less possible liquid remains inside the pack at the end of the extraction and when the pack must be removed from the system to be thrown to the bin.

30

The pack chamber can comprise an upper pack inlet to introduce the new pack.

Preferably, the pack chamber presents a bottom opening configured to enable an access of a fluid processing device to the bottom of said pack hold in the chamber. This access or passage is particularly designed to enable the relative movement of the fluid processing device to the bottom of the pack when it is hold inside the pack holder area.

35

The fluid processing device comprises a body that comprises an upwardly pointed, tapered or sharp end. This end is designed to open the bottom side of the pack, preferably by piercing, when this tip end is moved upwardly against the bottom side of the pack or
5 alternatively when the pack is moved downwardly to the fluid processing device.

The body of the piercing and fluid processing device comprises at least one internal inlet conduit for introducing the diluent into the pack. This fluid enables the preparation of a beverage by mixing with the beverage ingredient contained in the pack.

The body of the piercing and fluid processing device comprises at least one internal outlet
10 conduit for dispensing the prepared beverage. This beverage outlet is distinct from the inlet conduit.

Inlet and outlet conduits are provided inside the body of the fluid processing device which enables a better guidance of the liquids in and out of the pack, meaning no loss of liquids, no dirtiness and optimal preparation and dispensing.

15 Usually, the ends of the inlet and outlet conduits emerge close to the upwards end of the body of the fluid processing device.

The machine comprises an actuator to move the piercing and fluid processing device :
between two different positions, said positions comprising :
20 - one retracted position where the device is out of the pack. This position corresponds to the stand-by position.

and

- another operation position where the device is positioned inside the pack during the beverage preparation and beverage dispensing.

25 The upwardly pointed end of the body is designed to open the bottom side of the pack when this pointed end is urged against the openable area of the pack that is hold in the pack holding area.

When the operative position is reached, the pointed end protrudes inside the internal volume of the pack so that the respective ends of both conduits emerge inside the pack, that is to
30 say the end of the internal inlet conduit emerges in this internal volume and the end of the internal outlet conduit is positioned in this internal volume. Accordingly, introduced diluent and prepared beverage are urged to circulate through these internal conduits only.

In a third aspect, there is provided a beverage production system comprising a pack and a
35 beverage preparation machine for producing a beverage from said pack,

- said pack comprising a beverage ingredient, said ingredient being configured to be mixed with a fluid to produce a beverage, said pack presenting a plane shape oriented along a plane (P), and the bottom side of said pack being configured for being openable,

- said machine comprising:

5 . a pack holding area adapted for receiving and holding said pack in the machine so that the plane (P) of the plane shape is oriented in an essentially vertical position, and

. a piercing and fluid processing device for piercing the pack, for providing diluent inside the pack to prepare of a beverage by mixing said fluid with an ingredient contained in said pack and for dispensing the beverage from the pack, said piercing and fluid processing device

10 comprising:

- a piercing end, and

- a diluent inlet conduit for introducing a diluent into said pack, and

- a beverage outlet conduit for dispensing the beverage from said pack, and

15 . a diluent supply system connected to the diluent inlet conduit of the piercing and fluid processing device, and

. an actuator to transfer the piercing and fluid processing device:

- from a retracted position outside of the pack,

- to an operation position within the pack where the piercing end projects inside the pack and the diluent inlet conduit and beverage outlet conduit of the piercing and fluid

20 processing device are oriented in an essentially vertical position,

wherein the beverage inlet end of the beverage outlet conduit of the piercing and fluid processing device comprises multiple outlet holes.

This system comprises a pack comprising a food or beverage ingredient able to produce a beverage further to mixing with an aqueous fluid, preferably water.

25

In addition, the system comprises a machine for producing a beverage from the pack, as already described.

In the present application:

30 - the terms "upstream" and "downstream" are defined in relation with the direction of a fluid, either diluent, beverage or air, through a conduit of the fluid processing device.

- the terms "upper" and "lower" are defined in relation with the position of the fluid processing device when said device is positioned in its operative position as illustrated in Figures 4A, 4D, 4E, 4F or 5.

35

The above aspects of the invention may be combined in any suitable combination. Moreover, various features herein may be combined with one or more of the above aspects to provide

combinations other than those specifically illustrated and described. Further objects and advantageous features of the invention will be apparent from the claims, from the detailed description, and annexed drawings.

5 **Brief description of the drawings**

Specific embodiments of the invention are now described further, by way of example, with reference to the following drawings in which:

- Figure 1 is a schematic drawing of a beverage production system according to the invention,
- 10 - Figure 2 illustrates the pack that can be used in the beverage production system of the invention,
- Figure 3 is perspective view and a cross-section view of a piercing and fluid processing device used in a beverage production system according to the state of the art,
- Figure 4A is a side view of the piercing and fluid processing device according to the invention,
- 15 - Figure 4B is a front view of the piercing and fluid processing device according to the invention,
- Figure 4C is a top view of the piercing and fluid processing device according to the invention,
- 20 - Figures 4D and 4E are longitudinal cross-sections of the fluid processing device according to the invention,
- Figure 4F comprises a perspective view of the piercing and fluid processing device comprising two sub-parts,
- Figure 4G comprises isolated views of the sub-parts of Figure 4F,
- 25 - Figure 5 is longitudinal cross section of the pack cooperating with the piercing and fluid processing device in its operation position.

Detailed description of exemplary embodiments

30 **Figure 1** illustrates schematically a beverage production system 100 according to the invention.

The system 100 comprises a machine 1 and a pack 10. The machine is adapted for receiving the pack and producing a beverage from said pack.

The machine 1 comprises a pack holding area 2 and a diluent supply system to introduce a diluent inside the pack.

35 The fluid system usually comprises a fluid source 31, like a water tank, pumping means 32 to pump the fluid from the source. Usually heating and/or cooling means 35 are part of the diluent system to adapt the temperature of the fluid to be introduced inside the pack.

The fluid is supplied to a piercing and fluid processing device 11 configured to cooperate with the bottom of the pack in order to introduce the diluent in said pack.

Generally, the machine comprises an actuating device 33 to move this piercing and fluid processing device 11 to said pack held in the pack receiving area 2.

5 The machine comprises usually a system control unit 34 to control the above different devices for the preparation of a beverage from a pack.

Such a beverage production system 100 can correspond to the system described in the publications WO 2021/110650, WO 2021/110654, WO 2021/110652 and/or WO 2023/144302.

10

Figure 2 is a perspective view of a pack 10 that can be used in the beverage production system 100 according to the invention.

This pack comprises an ingredient that is configured to be mixed with a fluid to produce a beverage. The pack presents a plane shape oriented along a plane P. Two longitudinal
15 plane walls 105 (front and back) extends along this plane P.

In this specific embodiment, the walls 105 are made of a flexible material and the lateral edges 106 of these walls are sealed, as well as the edges at the top end 107. The bottom side 101 of said pack is configured for being openable. The bottom side 101 comprises an area 104 that is an openable area. This area 104 is configured for being openable by the
20 piercing and fluid processing device 11 of the system. This openable area 104 is adapted to enable the introduction of the piercing and fluid processing device 11 so that said device protrudes inside the internal volume of the pack in order to introduce the fluid and to collect and dispense the beverage, as illustrated in Figure 5.

This openable area 104 of the pack can be configured as described in WO 2023/144302.

25

Preferably, the pack can comprise holes 103 at the bottom end and positioned around the openable area 104. These holes are adapted to cooperate with two positioning means of the pack receiving area, in particular two pins configured to enter these holes so that the pack remains fixed inside the receiving area during the opening of the openable area 104 by the
30 piercing and fluid processing device 11: this opening is obtained by the upwards movement of this device through the openable area. The piercing and fluid processing device is moved upwardly until it reaches its operation position illustrated in **Figure 5**.

Generally, in the operative position, the pointed end 113 of the fluid processing device extends by about 10 mm, preferably 13 mm, above the openable area 104 of the pack.

35

Figure 3 is perspective view and a cross-section view of a fluid processing device 11 that can be used in the beverage production system according to the state of the art.

The body of this device 11 comprises a main core part 117, that is preferably essentially cylindrical, and an upwardly pointed end 113, which preferably presents a conical shape extending from the main core part.

This body comprises:

- 5 - an internal inlet conduit 111 for driving a fluid, preferably water, to the pointed end 113, as illustrated by the arrow W, and
- an internal outlet conduit 112 for driving the prepared beverage from the internal volume of the pack in a downward direction as illustrated by arrow B.

By internal, it is meant that these conduits extend inside the body and not along the surface of the body. Consequently, when the piercing and fluid processing device is introduced in a pack, liquids flow in and out of the pack through these internal conduits 111, 112 which provide a better guidance.

Due to the presence of two conduits inside the fluid processing device, generally, the piercing and fluid processing device presents a rather large transversal section. For a fluid processing device presenting a circular transversal section, usually the diameter of the fluid processing device is of at least 5 mm, usually at most 15 mm, preferably comprised between 5 and 12 mm, even more preferably comprised between 6 and 10 mm.

Both conduits are distinct one from the other. The conduit 111 presents a diluent outlet end 111b that emerges at the upper part of the body. The conduit 112 presents a beverage inlet end 112a at the upper part of the body.

Preferably, the end 111b of the inlet conduit is designed so as to orientate a jet of fluid upwardly inside the pack.

The actuating device 33 (Figure 1) is adapted to move this fluid processing device 11 to the pack 10 held by the pack receiving area 2 and in particular the pointed part 113 to the openable area 104 in order to open the openable area 104 or any membrane or cover provided at this area. In an alternative embodiment, the actuator 33 can be adapted to move the openable area 104 of the pack to the piercing and fluid processing device 11.

With this piercing and fluid processing device of the state of the art, it was observed that with packs comprising a powder ingredient, in particular milk powder, the system did not dispense a beverage correctly: lumps of non-dissolved powder remained in the pack or were dispensed as such from the device inside the drinking cup. The resulting beverage presented a gradient of concentration with the more concentrated part at the bottom of the cup. It was observed that lumps did not dissolve in the cup after dispensing.

Figures 4A-4C illustrate the preferred embodiment of the piercing and fluid processing device according to the invention.

The inlet 112a of the beverage outlet conduit of the piercing and fluid processing device

comprises multiple outlet holes 1121.

This configuration enables the design of a minimal cross section area inside the beverage outlet conduit that avoids the creation of overpressure inside the pack during the beverage preparation and the non-desirable sucking effect. This area is fixed according to the values of the flows that can be provided by the diluent supply system through the diluent inlet 111 of the piercing and fluid processing device. For example, for a flow of diluent entering the inlet conduit comprised between 50 and 400 ml/min, preferably the global surface defined by the multiple outlet holes is of at least 25 mm², preferably 27 mm².

Simultaneously, each of the multiple outlet holes 1121 can present a quite small dimension d (Figure 4C) that prevents lumps of powder from falling through the large cross section of the beverage outlet conduit. In the illustrated embodiment, the smallest dimension of the multiple outlet holes is of 0.4 mm.

According to this preferred embodiment, the multiple outlet holes present the shape of slots designed and oriented so that the longest dimension of a slot extends essentially along the longitudinal direction of the beverage conduit 112.

Foamed milk can be efficiently produced from packs of milk powder presenting an internal volume comprised between 20 and 35 ml. No lumps of powder were observed, milk liquid presented an homogeneous aspect and a very fine foam at its top.

As illustrated in the preferred embodiment of **Figure 4D**, the cross area of the outlet conduit decreases from its inlet end 112a to the minimal cross section S and then can slightly increase again to the outlet end 112b. In the illustrated embodiment, the cross section at the outlet end 112b is of 12.2 mm² for a flow of diluent entering the inlet conduit comprised between 50 and 400 ml/min

Preferably the end 112b of the beverage outlet conduit of the piercing and fluid processing device is connected to a downwardly oriented guiding surface 114 that guides the beverage and its foam directly to a drinking cup positioned below (as illustrated in Figure 1). This guiding surface decreases down to a tip end 1141. In the illustrated embodiment, the guiding surface extends by a length of 2 mm along the beverage flow direction.

Figures 4D and 4E are cross sections of the piercing and fluid processing device of Figures 4A-4C where cross-sections extend along the diluent inlet conduit 111. Figures 4D and 4E differ by the part of the orientation of the view along the cross-section.

Figure 4D illustrates the local restricted section 115 in the inlet conduit 111 that enables the production of a jet of diluent downstream this section and inside the pack. This jet of diluent increases the mixing of the diluent with the beverage ingredient and the dissolution of the beverage ingredient.

Figure 4E illustrates the outlet end 116b of an air inlet conduit designed to drive air the downstream side of the local restricted section 115. Preferably, the inlet 116a of this air inlet

conduit is provided on a lateral side of the body 114 of the piercing and fluid processing device as illustrated in Figure 4A. This position limits deposits of the produced beverage in the inlet and a potential blockage of the inlet of the conduit.

5 **Figure 4F** illustrates the particular embodiment of the piercing and fluid processing device of the invention made of two dismountable upper and lower sub-parts 11', 11". The upper part 11' was made transparent to illustrate the air inlet end 116a at the junction of the two sub-parts.

10 **Figure 4G** comprises isolated views of the sub-parts of Figure 4F. The upper part 11' comprises:

- the piercing end 113,
- the downstream part of the inlet conduit 111 that includes the local restricted section 115,
- the multiple outlet holes 1121,
- at least a part of the air conduit provided at the local restricted section 115 of the diluent

15 inlet conduit as illustrated in Figure 4E.

This dismountable configuration enables an easier manufacture of the multiple outlet holes of the device, the air conduit and the diluent inlet conduit, in particular by plastic injection moulding.

20 Preferably, the upper part 11' can comprise the downstream part of the air conduit when such a conduit is provided at the downstream side of the local restricted section of the diluent inlet conduit.

The lower part 11" comprises:

- the downstream part of the beverage conduit that includes the beverage guiding surface 114
- the upstream part of the air conduit including the air inlet 116a.

25

Although the invention has been described with reference to the above illustrated embodiments, it will be appreciated that the invention as claimed is not limited in any way by these illustrated embodiments.

30 Variations and modifications may be made without departing from the scope of the invention as defined in the claims. Furthermore, where known equivalents exist to specific features, such equivalents are incorporated as if specifically referred in this specification.

As used in this specification, the words "comprises", "comprising", and similar words, are not to be interpreted in an exclusive or exhaustive sense. In other words, they are intended to mean "including, but not limited to".

35

List of references in the drawings :

system

100

	module	1
	piercing and fluid processing device	11
	upper part	11'
	lower part	11"
5	diluent inlet conduit	111
	diluent inlet end	111a
	diluent outlet end	111b
	beverage outlet conduit	112
	beverage inlet end	112a
10	outlet holes	1121
	beverage outlet end	112b
	piercing end	113
	beverage guiding surface	114
	tip end	1141
15	restricted section	115
	downstream side	115b
	air inlet conduit	116
	air inlet end	116a
	air outlet end	116b
20	body cylindrical part	117
	fluid source	31
	pumping means	32
	actuator	33
	system control unit	34
25	heating and/or cooling means	35
	pack holding area	2
	pack	10
	bottom side	101
	hole	103
30	openable area	104
	wall	105
	lateral edge	106
	top end	107

CLAIMS

1. A piercing and fluid processing device (11) of a beverage preparation machine (1) for producing a beverage from a pack (10), said pack (10) comprises a beverage ingredient
5 configured to be mixed with a fluid to produce a beverage, said pack (10) presenting a plane shape oriented along a plane (P), and the bottom side (101) of said pack (10) being configured for being openable,
said piercing and fluid processing device (11) being for piercing said pack (10), for providing diluent inside said pack (10) to prepare a beverage by mixing said diluent with an ingredient
10 contained in said pack (10) and for dispensing the beverage from said pack (10), said piercing and fluid processing device (11) comprising:
- a piercing end (113),
- a diluent inlet conduit (111) for introducing said diluent into said pack (10), and
- a beverage outlet conduit (112) for dispensing said beverage from said pack (1),
15 wherein a beverage inlet end (112a) of said beverage outlet conduit (112) comprises multiple outlet holes (1121).
2. The piercing and fluid processing device (11) according to the precedent claim, wherein
20 the smallest dimension of said multiple outlet holes (1121) is of at most 0.7 mm, preferably at most 0.6 mm, even more preferably at most 0.5 mm.
3. The piercing and fluid processing device (11) according to any one of the precedent claims, wherein the global surface defined by said multiple outlet holes (1121) is of at least
25 25 mm², preferably at least 27 mm² for a flow said diluent entering the diluent inlet conduit (111) comprised between 50 and 400 ml/min.
4. The piercing and fluid processing device (11) according to any one of the precedent claims, wherein the cross area of said beverage outlet conduit (112) decreases from said
30 beverage inlet end (112a) to a beverage outlet end (112b).
5. The piercing and fluid processing device (11) according to the precedent claim, wherein the smallest cross section (S) of said beverage outlet conduit (112) is of at least 8 mm² for a flow of diluent entering said diluent inlet conduit (111) comprised between 50 and 400
35 ml/min.

6. The piercing and fluid processing device (11) according to any one of the precedent claims, wherein the length of said beverage outlet conduit (112) is of at least 10 mm.
7. The piercing and fluid processing device (11) according to any one of the precedent claims, wherein said multiple outlet holes (1121) present the shape of slots, and wherein said slots are oriented so that the longest dimension of a slot extends essentially along the longitudinal direction of said beverage outlet conduit (112).
8. The piercing and fluid processing device (11) according to any one of the precedent claims, wherein said beverage outlet end (112b) of said beverage outlet conduit (112) is connected to a downwardly oriented beverage guiding surface (114), said beverage guiding surface (114) decreasing down to a tip end (1141).
9. The piercing and fluid processing device (11) according to the precedent claim, wherein the downwardly oriented guiding surface (114) extends by at least 2 mm from the beverage outlet end (112b).
10. The piercing and fluid processing device (11) according to any one of the precedent claims, wherein said inlet conduit (111) comprises a restricted section (115) in order to produce and introduce a jet of said diluent in said pack (10).
11. The piercing and fluid processing device (11) according to the precedent claim, wherein said piercing and fluid processing device (11) comprises an air inlet conduit (116) and an air outlet end (116b) of said air inlet conduit (116) emerges at the downstream side (115b) of said restricted section (115) of said diluent inlet conduit (111).
12. A beverage preparation machine (1) for producing a beverage from a pack (10), said pack (10) comprises a beverage ingredient configured to be mixed with a fluid to produce a beverage, said pack (10) presenting a plane shape oriented along a plane (P), and the bottom side (101) of said pack (10) being configured for being openable, said beverage preparation machine (1) comprising:
- . a pack holding area (2) adapted for receiving and holding said pack (10) in said beverage preparation machine (1) so that the plane (P) of said plane shape is oriented in an essentially vertical position, and
 - . a piercing and fluid processing device (11) for piercing said pack (10), for providing diluent inside said pack (10) to prepare a beverage by mixing said diluent with an ingredient

contained in said pack (10) and for dispensing the beverage from said pack (10), said piercing and fluid processing device (11) comprising:

- a piercing end (113),
- a diluent inlet conduit (111) for introducing said diluent into said pack (10), and
- 5 - a beverage outlet conduit (112) for dispensing said beverage from said pack (10),
- . a diluent supply system connected to said diluent inlet conduit (111) of said piercing and fluid processing device (11), and
- . an actuator (33) to transfer said piercing and fluid processing device (11):
- from a retracted position outside of said pack (10),
- 10 - to an operation position within said pack (10) where said piercing end (113) projects inside said pack (10) and said diluent inlet conduit (111) and beverage outlet conduit (112) of said piercing and fluid processing device (11) are oriented in an essentially vertical position,

wherein said beverage inlet end (112a) of said beverage outlet conduit (112) of said piercing and fluid processing device (11) comprises multiple outlet holes (1121).

13. A beverage production system comprising a pack (10) and a beverage preparation machine (1) for producing a beverage from said pack (10),

- said pack (10) comprising a beverage ingredient, said ingredient being configured to be
- 20 mixed with a fluid to produce a beverage, said pack (10) presenting a plane shape oriented along a plane (P), and the bottom side (101) of said pack (10) being configured for being openable,

- said machine (1) comprising:
- . a pack holding area (2) adapted for receiving and holding said pack (10) in the machine so
- 25 that the plane (P) of the plane shape is oriented in an essentially vertical position, and
- . a piercing and fluid processing device (11) for piercing said pack (10), for providing diluent inside said pack (10) to prepare a beverage by mixing said diluent with said ingredient contained in said pack (10) and for dispensing said beverage from said pack (10), said piercing and fluid processing device (11) comprising:

- 30 - a piercing end (113),
- a diluent inlet conduit (111) for introducing said diluent into said pack (10), and
- a beverage outlet conduit (112) for dispensing said beverage from said pack (10),
- . a diluent supply system connected to said diluent inlet conduit (111) of said piercing and fluid processing device, (11) and
- 35 . an actuator (33) to transfer said piercing and fluid processing device (11):
- from a retracted position outside of said pack (10),

- to an operation position within said pack (10) where said piercing end (113) projects inside said pack (10) and said diluent inlet conduit (111) and beverage outlet conduit (112) of said piercing and fluid processing device (11) are oriented in an essentially vertical position,
- 5 wherein said beverage inlet end (112a) of said beverage outlet conduit (112) of said piercing and fluid processing device (11) comprises multiple outlet holes (1121).