The THERMOCOOLER System

Description of treatment method and plant components

DELLA TOFFOLA

ThermoCooler

Index

DELLA TOFFOLA

DELLA TOFFOLA

The Vinification of Red Grapes

Considerations

Vinification is the combination of operations by which grapes are transformed first into must and subsequently into wine.
These operations can differ greatly depending on the grapes to be processed and the desired end product.
The following considerations are limited specifically to the vinification of red grapes processed in such a way as to obtain two distinct ranges of products:

- Red wine of superior quality, rich in colour and extracts, stable over time and suitable for ageing
- Young red and rose wines ready for drinking

To obtain young wines, ready to drink, the liquid and solid parts must be separated quickly and the fermentation step correctly controlled.
In this regard one has to remember the importance of carbonic maceration, a step allowing the production of new wines rich in colour, with low tannin levels and no malic acid.
Nevertheless, most red wines are produced for drinking over time and so the main objectives in the vinification of red grapes are:

- Extraction of colouring pigments (anthocyans)
- Extraction of elements that make up the structure (noble tannins)
- Extraction of varietal aromas and aroma precursors
- Achieving maximum stability of extracted products over time

In tests conducted by Della Toffola it was found that the dregs of crushed grapes sent to distilleries still contain a significant quantity of polyphenolic substances.
The exact quantity varies between 30% and 50% of the total initial polyphenolic substances, depending on the vintage and the cultivar.

DELLA TOFFOLA

This significant quantity of useful substances can constitute a genuine *TECHNOLOGICAL RESERVE.*
It is possible to extract appreciable final benefits for the wine from this consistent unused residual fraction, which would otherwise be lost.
In order to take full advantage of this reserve, the wine-maker can make use of the following, distinct operations:

- Increase the time the must and the solids remain in contact
- Increase the number of *remontages*, whether manually or using mechanised winemaking equipment of whatever type and design
- Increase the maceration temperature
- Exploit the solvent properties of the alcohol
- Increase the dosage of sulphur dioxide
- Make use of oxygenation
- Add specific enzymes

All these operations are effective in improving the coefficient of extraction of the substances required, but each brings with it various difficulties in application, especially where notable quantities are to be treated.
Experiments have also shown that, even using these methods, the highest percentage of extraction is no better than 15%.
In order to obtain a process that would most successfully combine all the individual advantages obtainable using these systems, and that could also increase the level of extraction, researchers at Della Toffola began some years ago the studies led to the creation of a method that improves extraction by up to 50%.
The method was named *COOLER*.
Given that the method is based on the instantaneous injection of crushed, stemmed and rapidly heated grapes into a hard vacuum, the *COOLER* unit was set up to operate in tandem with the tried and tested *THERMOCOMPACT* heating unit.
The combination of these two units constitutes the new, innovative and complete vinification system known as *THERMOCOOLER*.

General Features

The *THERMOCOOLER* system represents an instrument as fundamental as it is new, which allows the winemaker,

- ▶ *TO EXTRACT THE FULL POLYPHENOLIC POTENTIAL OF THE GRAPES*
- ▶ *TO WIDEN THE RANGE OF TECHNOLOGICAL POSSIBILITIES*
- ▶ *TO DIVERSIFY PRODUCTION*

This is a process based on two treatments to which the crushed grapes are subjected in quick succession:

1) Rapid heating
2) Instantaneous expansion of the grape induced by a hard vacuum

Result of vinification tests conducted using a 1,5 tonne COOLER unit.

Advantages of the system

- ▶ Exploits the effect of high temperatures to inhibit damaging enzymes (polyphenol oxidase, laccase)
- ▶ Makes the cell walls more fragile allowing a quicker and more thorough diffusion of macro molecules, namely:
  Anthocyans, which provide colour.
  Tannins, which contribute to structure.
  Volatile compounds: aromas or aroma precursors
- ▶ Immediate cooling of the crushed grapes induced by expansion in a vacuum
- ▶ Maximum exploitation of the *TECHNOLOGICAL RESERVE* held by the grapes
- ▶ Increased extraction of tannins and anthocyans, giving products with balance and body
- ▶ Stability of the extracted compounds

This procedure also allows winemakers to maximize the use of their fermentation tanks, as maceration times are significantly reduced.

DELLA TOFFOLA

Main steps of the process

- Run-off (20/50%)
- Rapid heating of the stemmed grapes (70/85°C)
- Instantaneous injection into a strong vacuum

Effects of the process

Instantaneous cooling of the crushed grapes by auto-evaporation. The final balanced temperature depends on the heating temperature (70/85°C) and the pressure of the vacuum (from 30 to 100 mBar).
Weakening of the grape cell walls by the formation of microscopic cracks favouring the diffusion of polyphenolic compounds during fermentative maceration.

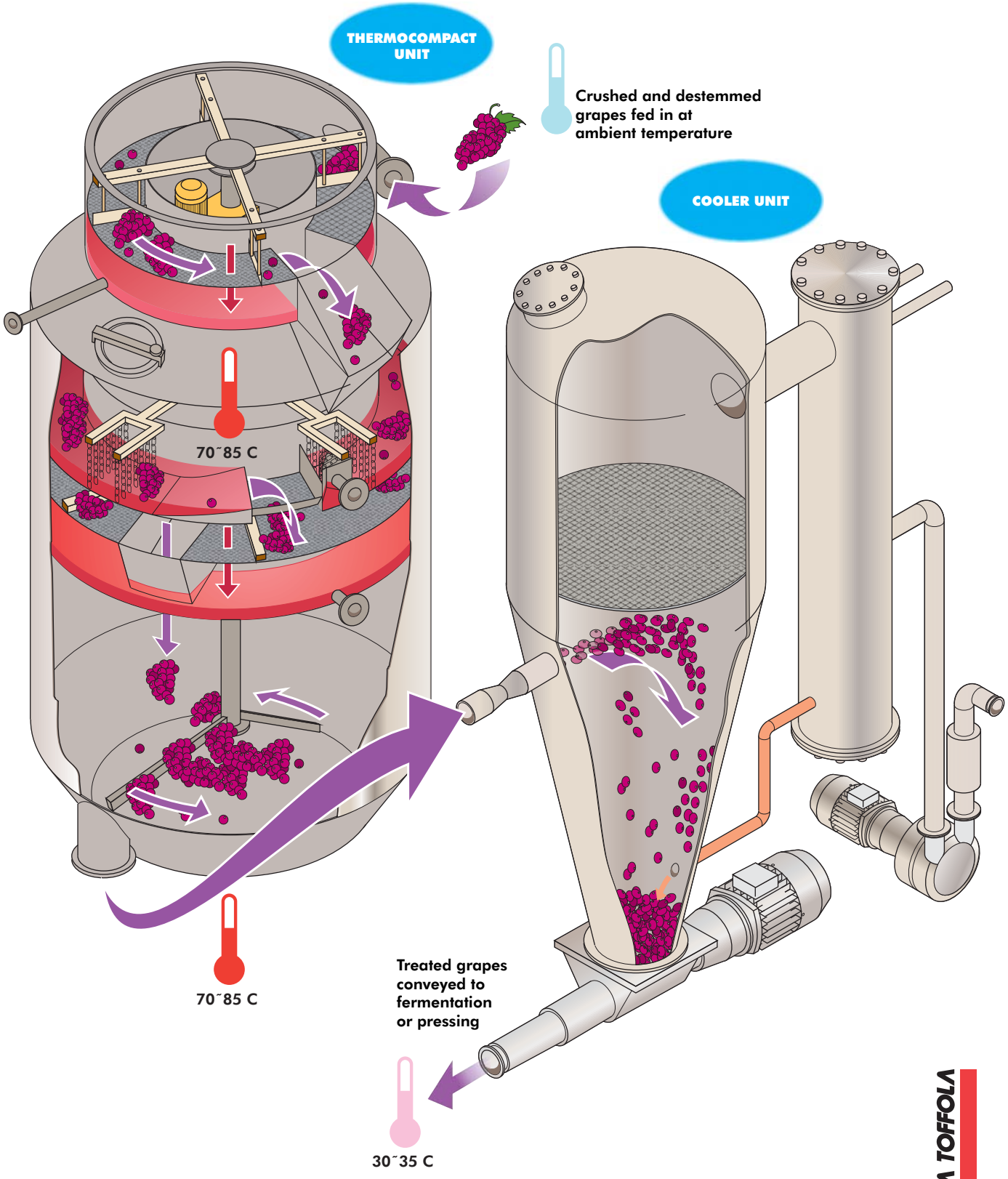
Description of the elements making up the THERMOCOOLER system

- *THERMOCOMPACT* unit allowing a partial run-off of juice and rapid heating of the crushed grapes by immersion. The machine has a holding tank allowing preliminary maceration
- A sealed pump feeding crushed grapes into the expansion chamber continuously
- A *COOLER* unit inducing auto-evaporation of the intracellular water and thus causing the skin of the grape to crack
- Both the *THERMOCOMPACT* and the *COOLER* units are made entirely of AISI 304 stainless steel

DELLA TOFFOLA

The THERMOCOOLER System

Schematic illustration of process



DELLA TOFFOLA

DELLA TOFFOLA

Features of operation

The *THERMOCOMPACT* unit is the first element in a *THERMOCOOLER* plant.
It serves essentially to heat the crushed and stemmed grapes, separated from the free-run juice, by immersing them in an annular bath of hot must.
The heated grapes are then collected in a tank forming part of the unit, where they can also macerate for up to 60 minutes.
From this tank, the crushed grapes are then sent to the *COOLER* unit.
In the absence of the *COOLER* unit, the grapes can be direct straight to the pressing step. The must is subsequently cooled.

Objectives

- *MAXIMUM CARE OF THE RAW MATERIAL*
- *NO MECHANICAL AGRESSION*
- *RAPID AND UNIFORM HEATING THANKS TO THE USE OF AN INNOVATIVE SYSTEM*

How the THERMOCOMPACT works

1) The crushed and stemmed grapes are made to pass initially around a circular run-off section, swept by paddles coupled to the central motor.
2) Between 20 and 50% of the virgin rosé must is extracted and collected in a storage tank.
   After juice has run off in the first section, the crushed grapes are immediately immersed in a ring of hot must and heated rapidly.
   The must needed to maintain the temperature of the hot annular bath is recirculated continuously through a relative heat exchanger by a pump.

3) The rotary flow path is such that the must and the grapes overflow continuously into a second section. The part of the must used for heating is collected in a tank maintained at a constant level, recirculated by the pump and returned to the correct temperature. The remainder of the crushed grapes and must will continue to be conveyed by the action of the paddles, powered by the motor.
4) The crushed grapes directed through the second section fall ultimately into the collection and maceration tank below.
5) The hot crushed grapes are then extracted and can be sent to the

COOLER unit, or to the pressing step and subsequent liquid fermentation.

FEATURES OF THE THERMOCOMPACT UNIT

THERMOCOMPACT units can also be used without the *COOLER* station, if the process is one involving only a hot pre-fermentation maceration.

In this case, use of the *THERMOCOMPACT* offers the following advantages:

- Inhibition of polyphenol oxidase and laccase
- Flexibility in the extraction of colouring pigments
- Complete management of fermentation in the liquid phase
- Integrity of the grape maintained
- Maximum versatility of use even when treating different products
- Easy integration into existing plants and wineries
- Suitable for processing red grape must prior to subsequent concentration

The THERMOCOMPACT Unit

Schematic illustration of operation

Rotating arms

Crushed and Stemmed Grapes fed

Ambient Temp.

1st Run-off Grid, Red Must

Ambient Temp.

Red must Outlet

Chute Conveying Product to be Treated

70˜85 C Annular bath of Hot Must

Must fed in Hot

2nd Run-off Grid, Treated Grapes

Opening to admit Product for Maceration

Must returned for reheating

Maceration Tank

70˜85 C Product conveyed to COOLER Unit

DELLA TOFFOLA

Operating Principle

The injection of the stemmed and heated grapes into an expansion chamber in a hard vacuum induces the instant evaporation of intracellular water: this in turn causes the cell walls of the grape to crack immediately.
The diagrams and the electron microscope photographs which follow illustrate how the formation of a web of surface cracks in the skin of the grape has the effect of favouring the diffusion of those polyphenolic and aromatic compounds that cannot be extracted in traditional vinification.
In this way, as demonstrated in the results of tests conducted, the *TECHNOLOGICAL RESERVE* that would otherwise be lost using traditional methods can be fully exploited by winemakers.

Complete THERMOCOOLER Unit
Installed at the Villa Banfi winery in Montalcino (Siena)

The crushed grapes are heated rapidly to a temperature of 70/85°C and injected into a conical chamber pumped down to a hard vacuum (between 30 and 50 mBar).
This results in the automatic evaporation of intracellular water, and causes the surface of the grape skins to crack.
The vapours given off as the crushed grapes expand are recovered in a condenser cooled by recirculating water.
The vacuum pump is connected directly to the condenser.
The negative pressure that can be generated in a *COOLER* unit is directly proportional to the quantity and temperature of the water being in recirculation.
At the bottom of the conical chamber, a sealed pump (single screw) draws off the grapes and directs them to the fermentative maceration vats or the press; the must is then cooled.

A 1,5 tonne/hour plant

Description of the elements making up a *COOLER* Unit.

- Fluid-tight conical expansion chamber
- Vacuum Pump
- Vapour recovery condenser, cooled by recirculating cold water
- Pump for recovery of condensate (8/12% of total mass)
- Pump drawing off and conveying crushed grapes to successive processing steps
- Devices for automatic monitoring and control of temperature and vacuum
- Construction using AISI 304 stainless steel throughout

Detail of single screw pump by which treated product is drawn off from the COOLER unit

The COOLER Unit

Schematic illustration of operation

Condensation Water
Inlet / Outlet

Expansion Chamber
held at Vacuum of
30 to 50 mBar

Must Vapours drawn
into Condenser

Condenser

Separation Grid

70˜85 C

Product fed into
THERMOCOMPACT
Unit

Re-introduction of
Condensation Liquid

Vacuum Pump

Sight-glass for Observation
of Treated Product

Product drawn off by
Single Screw Pump

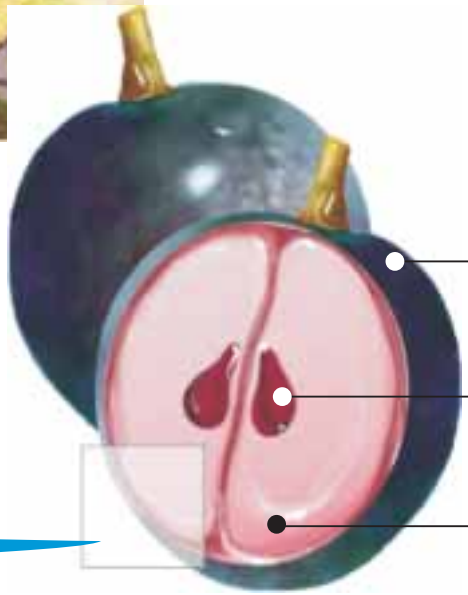
30˜35 C

Treated
Product Outlet

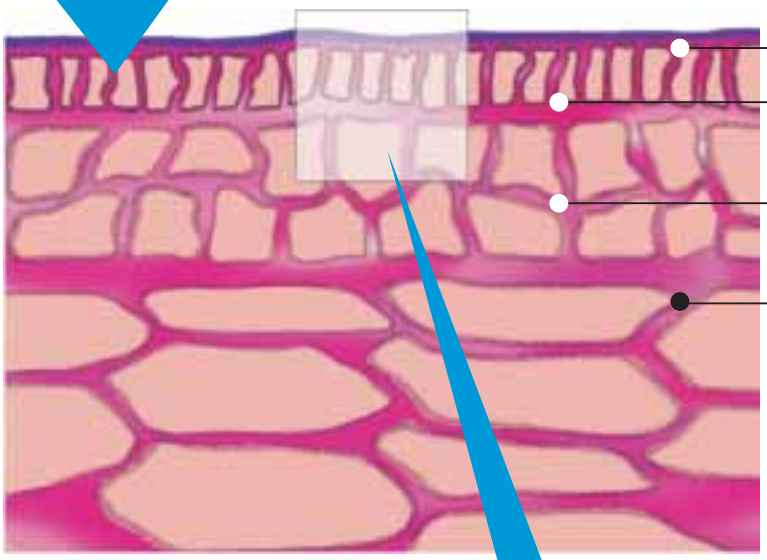
DELLA TOFFOLA

The Grape

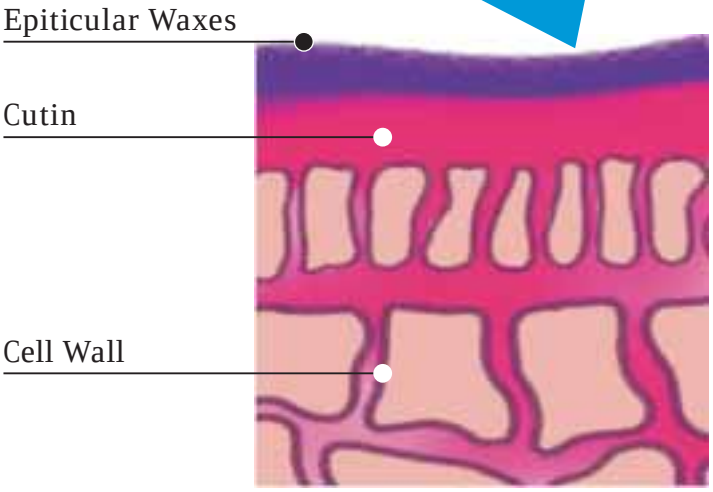
Cross-section of a Grape



Detail of the skin

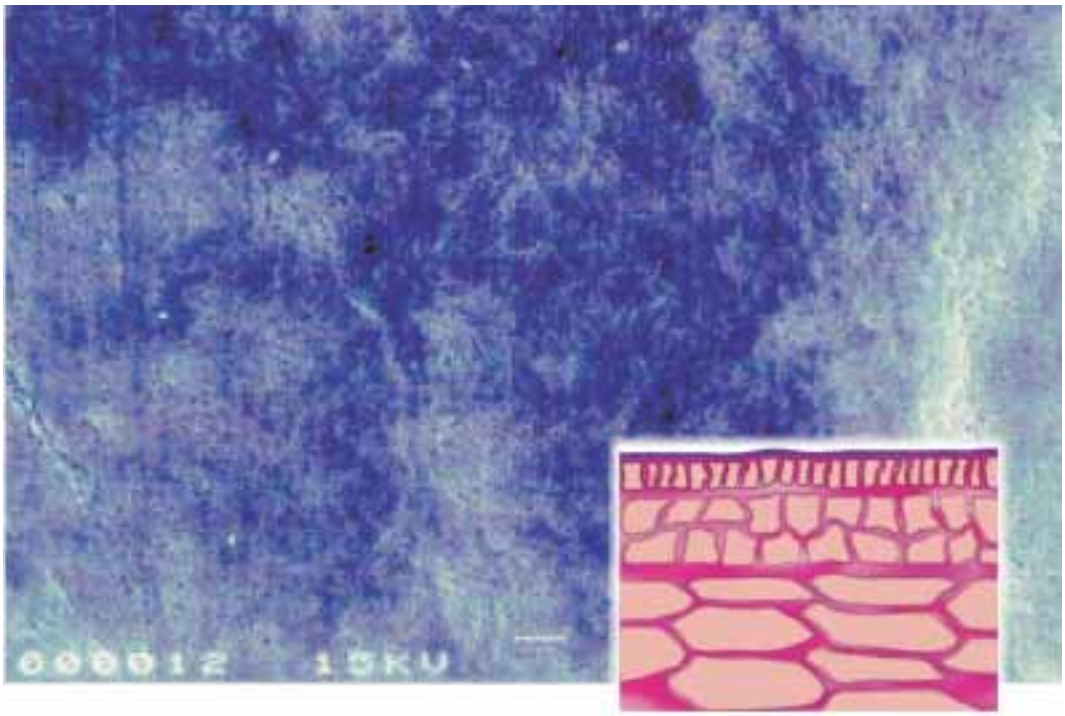


Detail of the Cuticle



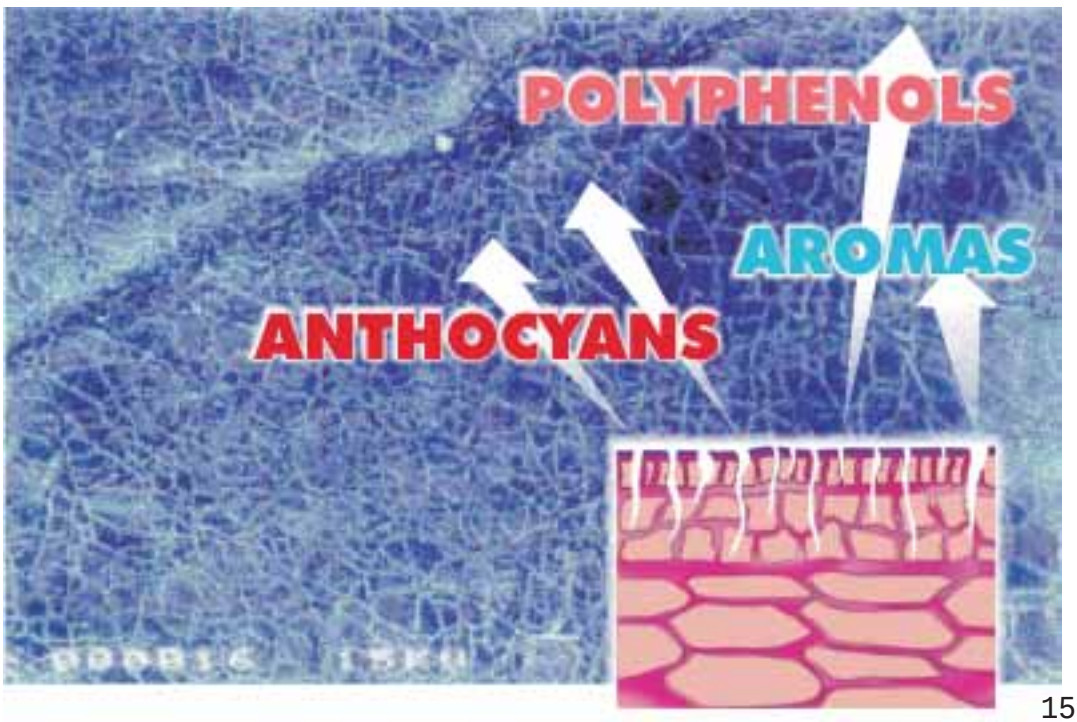
Effects of the Cooler Treatment

Microscope photograph of a grape skin before Cooler treatment



10 µm (10 thousandths of 1 mm)

Cracking effects observed on the skin after Cooler treatment



DELLA TOFFOLA

1. Syrah Grapes - Côte du Rhône

The table shows the results of analyses conducted during the 1995 Vintages in Côtes du Rhone (France) on "Syrah" type grapes.

TYPE OF ANALYSIS	RESULTS FROM SAMPLE UNDERGOING NORMAL VINIFICATION FOR 6 DAYS	RESULTS FROM SAMPLE UNDERGOING THERMOCOOLER VINIFICATION FOR 5 DAYS
Alcohol Level (% by Vol.)	11,8	12,25
pH	3,65	3,61
Volatile Acidity (g/litre of H_2SO_4)	0,30	0,24
Dry Extract (g/litre)	24,5	28,1
Anthocyans mg/litre	620	809
Tannins (Density Obt. 280 dil)	52,9	64,3
Colour Intensity (420 + 520 + 620)	11,9	13,7
Hue (420 + 520)	0,52	0,45

The sample that underwent normal vinification was analysed **6** days after maceration with one remontage per day.
The sample that underwent THERMOCOOLER vinification was analysed **5** days after maceration with one remontage per day.

1. Grenache Grapes - Côte du Rhône

The table shows the results of analyses conducted during the 1995 Vintages in Côtes du Rhone (France) on "Grenache" type grapes.

TYPE OF ANALYSIS	RESULTS FROM SAMPLE UNDERGOING NORMAL VINIFICATION FOR 6 DAYS	RESULTS FROM SAMPLE UNDERGOING THERMOCOOLER VINIFICATION FOR 6 DAYS
Alcohol Level (% by Vol.)	12,5	12,6
pH	3,51	3,47
Volatile Acidity (g/litre of H_2SO_4)	0,30	0,24
Dry Extract (g/litre)	23,2	27,6
Anthocyans mg/litre	468	589
Tannins (Density Obt. 280 dil)	43,1	51,7
Colour Intensity (420 + 520 + 620)	8,75	11,67
Hue (420 + 520)	0,49	0,47

The sample that underwent normal vinification was analysed **6** days after maceration with one remontage per day.
The sample that underwent THERMOCOOLER vinification was analysed **6** days after maceration with one remontage per day.

DELLA TOFFOLA

ThermoCompact

CAVE COOPERATIVE ST. MAURICE DE CAZEVIEILLE	1 x 60 tonne/h
CAVE COOPERATIVE LE POUGET	1 x 20 tonne/h
CAVE COOPERATIVE LAURE MINERVOIS	1 x 30 tonne/h
CAVE COOPERATIVE ST. DEZERY	1 x 20 tonne/h
CAVE COOPERATIVE LIMOUX ROUGE	1 x 60 tonne/h
CAVE COOPERATIVE TULETTE COSTES ROUSSES	1 x 20 tonne/h
CAVE COOPERATIVE VENDEMIAN	1 x 25 tonne/h
CAVE COOPERATIVE NARBONNE	2 x 20 tonne/h
CAVE COOPERATIVE LA LANGUEDOCIENNE ARGELIERS	1 x 40 tonne/h
CAVE COOPERATIVE VALROS	1 x 40 tonne/h
CAVE COOPERATIVE BOURDIC	1 x 60 tonne/h
CAVE COOPERATIVE ST MARTIN DE LONDRES	1 x 30 tonne/h
CAVE COOPERATIVE ST MAMERT DU GARD	1 x 30 tonne/h
CAVE COOPERATIVE RODAIX SEGUENT	1 x 30 tonne/h
CAVE COOPERATIVE VILLEDIEN	1 x 15 tonne/h
CAVE COOPERATIVE ESPIET	1 x 25 tonne/h
VINA CONCHA Y TORO - SANTIAGO	1 x 25 tonne/h
VINEDOS Y BODEGA LA AGRICOLA S.A. - MENDOZA	1 x 4 tonne/h
VINEA S.A. - MENDOZA	1 x 10 + 1 x 20 tonne/h
COOP. S. ISIDRO LABRADOR - CAMPO ARCIS - VALENCIA	1 x 20 tonne/h
CAVE COOPERATIVE ST GENIES DES MALGOIRES	1 X 60 tonne/h
CAVE COOPERATIVE VALFLAUNES	1 X 25 tonne/h
CAVE COOPERATIVE BRIGNON	1 X 25 tonne/h
CAVE COOPERATIVE FOISSAC	1 X 35 tonne/h

ThermoCooler

BANFI S.p.A.- MONTALCINO	1 x 10 tonne/h
GIORDANO S.p.A. CUNEO	1 x 5 tonne/h
CAVE COOPERATIVE STE. CECILE	1 x 30 tonne/h
CAVE COOPERATIVE SAUVETERRE DE GUYENNE	1 x 20 tonne/h
CAVE COOPERATIVE ROCHEGUDE	1 x 15 tonne/h
CAVE COOPERATIVE CAROMB	1 x 3 tonne/h
CAVE COOPERATIVE RABASTENS	1 x 12 tonne/h
CAVE COOPERATIVE LANDERROUAT	1 x 10 tonne/h
CAVE COOPERATIVE ROAIX SEGURET	1 x 12 tonne/h
CAVE COOPERATIVE VILLEDIEU	1 x 12 tonne/h
CAVE COOPERATIVE ESPIET	1 x 12 tonne/h
CAVE COOPERATIVE EUZET LES BAINS	1 x 25 tonne/h
CAVE COOPERATIVE ROUTIER	1 x 30 tonne/h
JUAN ANTONIO CONTE GRAND - S. JUAN	1 x 10 tonne/h
PENAFLOR S.A - MAIPU'	1 x 10 tonne/h
NICOLAS CATENA S.A. - MENDOZA	1 x 20 tonne/h
COMMERCIAL TEILLERY LT.DA - SANTA ANA	1 x 3 tonne/h
SIMEON WINES - LOXTON	1 x 30 tonne/h
CAVE COOPERATIVE ST. HILAIRE D'OZILHAN	1 x 20 tonne/h
CAVE COOPERATIVE MONTFRIN	1 x 20 tonne/h
CAVE COOPERATIVE VENDARGUES	2 x 30 tonne/h
CAVE COOPERATIVE PUILACHER	1 x 30 tonne/h
CAVE COOPERATIVE VILLEVEYRAC	1 x 40 tonne/h
CAVE COOPERATIVE VAISON LA ROMAINE	1 x 15 tonne/h
BODEGA TORRES	1 x 15 tonne/h

ThermoCooler

CRUSHED AND STEMMED GRAPES FED IN.

RING OF HOT MUST

COOLING TO 30 35°C BY EXPANSION IN CHAMBER WITH HARD VACUUM

HOLDING TANK, CRUSHED AND STEMMED GRAPES

HOLDING TANK, RED MUST

70÷85°C

THERMOCOOLER UNIT

FERMENTATION BY TRADITIONAL VINIFICATION

70÷85°C

30÷35°C

BLADDER PRESS

RED MUST TRANSFERRED TO STORAGE VATS

PARTIALOR TOTAL REINTRODUCTION OF RED MUST

CRUSHED GRAPES HEATED TO 70 85°C WITH INJECTION OF POLYPHENOL OXIDASE

PRE-FERMENTATIVE MACERATION MAX 60 MIN

VINIFICATION TANK

HEAT EXCHANGER

ROTATING VACUM FILTER

General diagram of thermovinification plant using the ThermoCooler system

DELLA TOFFOLA

DELLA TOFFOLA

Azienda Certificata
UNI EN ISO 9001:2000

DELLA TOFFOLA S.p.A.
Via Feltrina, 72 - 31040 SIGNORESSA DI TREVIGNANO (TREVISO) ITALY
Tel. +39 0423 6772 - Fax +39 0423 670 841
e-Mail dtgroup@dellatoffola.it - Internet www.dellatoffola.it

Numero Verde
800-803276
*SOLO PER L'ITALIA
ONLY FOR ITALY

DTF
ZAE de la Baume - BP 15,
34290 Servian (France)
Tél. +33 (0) 467 39 39 00 - Fax +33 (0) 467 39 39 01
e-Mail contact@dellatoffola.fr
Internet www.dellatoffola.fr

DELLA TOFFOLA IBERICA S.A.
P.I. Lentiscares, c/La Losa, S/N
26370 NAVARRETE LA RIOJA (ESPAÑA)
Tel. +34 941 440 420 Fax +34 941 440 571
e-Mail dti@dellatoffola.es

DELLA TOFFOLA SUDAMERICA Lim.
Avenida Puerta Sur
03400 SAN BERNARDO - SANTIAGO (CHILE)
Tel. +56-2 854 1170 Fax +56-2 854 1088
e-Mail jsolis@dellatoffola.cl
Internet www.dellatoffola.cl

DELLA TOFFOLA ARGENTINA S.A.
DT INOX S.A.
Carril Rodriguez Peña, 2271 Zona Industrial
5511 MAIPÙ - MENDOZA (ARGENTINA)
Tel./Fax +54 (0) 261 493 1929
e-Mail dellatoffolaargentina@dellatoffolaarg.com.ar
Internet www.dellatoffolaarg.com.ar

DELLA TOFFOLA GROUP