Current Viticulture Practices in Wine Grape Growing in India: Issues and Challenges with Reference to Processing

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The world's major viticulture regions fall into bands of areas, with average temperatures between 10 and 20 °C giving a good spatial proxy for the limits of grape and wine production. The dots on the map represent the wine regions studied in a global analysis by Gregory James and colleagues on the impacts of climate change on wine quality.
Grape growing regions in India
Varieties

• Global Scenario
  • Over 10,000 documented varieties within the sub-species Vitis vinifera (the "European" or "true" wine grapes).

• Red wine grape varieties
  Cabernet Sauvignon
  Merlot
  Syrah/Shiraz
  Malbec
  Zinfandel
  Tannat
  Cabernet Franc
  Petite Sirah
  Carignan
  Pinotage
  Tempranillo
White wine grape varieties

Chenin Blanc
Sauvignon Blanc
Chardonnay
Ugni Blanc/Trebbiano
Pinot Blanc
Pinot Gris
Riesling
Semillon
Viognier
Juicy: the characteristics of wine grape berry
Wine produced in vineyards
The Winegrape Quality Triangle

- Flavour & Character Requirements
- Maturity, Purity & Condition
- Protocols & Supporting Behaviours
Vineyards & Grape Quality

Vineyard Factors
- Genetic Potential
- Environment Potential
- Management Potential

Wine Grape Quality Factors
- Color
- Aroma
- Flavor
Factors affect wine quality

Soil
Minerality
Nutrients
Water quality and quantity
Climatic conditions
Bunch load
Berry size
Drying of berries on vines
Vine phenology and growth

- Bud-break
- Flowering
- Veraison
- Harvest
- Leaf fall

Fruit
Shoot
Root
Influence of temperature on grape composition

![Graph showing the effect of temperature on various grape composition components.

- **Sugar**: Increases up to a certain point, then decreases.
- **Malate**: Decreases as temperature increases.
- **Tartrate**: Decreases as temperature increases.
- **K or Proline**: Increases as temperature increases.
- **Other amino acids**: Increase as temperature increases.
- **Anthocyanins**: Decrease as temperature increases.

Coombe 1987

The graph illustrates the complex relationship between temperature and the concentration of different components in grape composition, with varying impacts on sugar, malate, tartrate, K or proline, other amino acids, and anthocyanins.
Effect of vineyard environment and management on grape maturation and composition
Establishment of vineyard on Y system
Canopy on Y System : Mechanization ?
Canopy on VSP system: Suitable for Mechanization
Material for Training System: Select as per suitability
Common fruit characteristics of over cropped vines

- Low soluble solids
- Low acidity
- High acidity
- Poor colour
- Susceptibility to sunburn
Common fruit characteristics of under cropped vines

• Vegetative and undesirable flavours
• High pH
• Poor colour
Balanced bunch load
Water stress

- Grapes cultivated under mild water stress can improve berry composition (Matthews et al., 1990; Smart et al., 1990)
- Can impact wine sensory attributes
- Water stress can also have many negative consequences
  - reduced yields (Smart et al., 1974)
  - diminished winter hardiness
- Therefore, water stress could be a negative determinant of terroir.
Water status and vine size

• Many relationships found from vintage from vintage across vineyards studied
• Site specific in terms of the relationship
• Some negatively correlated
  – Lower water status, bigger vines
  – Larger canopy, more evaporative demand
• Some positively correlated
  – Higher water status, bigger vines
  – Less stress more vegetative growth
• Timing of water stress comes into play
• May need to be further investigated
Regulated Deficit Irrigation (RDI) to save water and improve Sauvignon Blanc quality? (Greven et al. 2005)

- Water use in Sauvignon Blanc grapes, could be reduced by 40% without causing differences in yield or quality parameters.
- In an area like Marlborough where irrigation is additional rather than essential, seasonal differences are likely to be greater than irrigation treatment differences.
- Cutting the amount of irrigation reduced leaf area but none of the yield parameters.
- Reduction came from both a reduced leaf growth as well as earlier senescence.
- Stem sap flow measurements were found to accurately reflecting the vine canopy size and transpiration.
Stages of berry development

Stage 1: Flowering
Stage II: Green berry growth
Stage III: Arrest of green growth
Stage IV: Veraison

Stages of veraison

Stage 1: Sugar/water accumulation
Stage II: Arrest of phloem transport
Stage III: Dehydration
Stage IV: Raisining

(Arrest of berry flavorant synthesis)
(Deterioration of berry flavorants)

Stages of grape maturation
Uneven ripening

- Uneven ripening can present as bunches that contain small hard berries that remain green while other berries ripen. Bunches may have poor or uneven colouring.
- Unripe berries can lead to wines that are out of balance, with undesirable flavours, aromas and poor colour.
Predisposing elements
(causes for loss)

- Harvesting too early before the bunches have reached their full maturity.
- Producing excessive crop that is too high for the functioning leaf area.
- Unfavourable weather conditions during flowering
- High variability within a harvest unit.
Even Ripened Berries
**Varietal integrity:** Presence of varieties other than the one expected to be in the load is not tolerated by wineries

**Loss or risk potential**

- It is detrimental to wine quality when the desired flavours and aromas are altered through the mixing of varieties.
- Unwanted colour effects can occur in whites where red grape berries are present.
- Label integrity is affected if a greater amount than the allowable percentage has been mixed, thus damaging the winery’s reputation in the market.
- The presence of malvidin diglucoside components, being an indicator of hybrid grapes (non-vinifera), is not acceptable in wine destined for the European markets.
A schematic representation of the effect of some treatments which produce small berries and or low yield on sensory and fruit attribute payoff.
The goals of this website are:
- to present the current tools and methods being used in precision viticulture,
- to provide some useful tools and links for the users,
- to share knowledge and within field data,
- to gather and share experience and information on precision viticulture at an international scale.
Precision viticulture (PV)

- Grape yield maps are of fundamental importance for the development of PV
- A range of sources of spatial data (yield mapping, remote sensing, digital elevation models),
Spatial Aspects of Vineyard Management and Wine Grape Production

Some comments of Roberts, 1999:

• Site selection is the most important decision in wine quality.
• Developing the site to its potential requires thorough knowledge of soil & climate, and spatial variables.
• A soil classification system can be used for comparing sites, and for choosing rootstocks and vine spacing.
• Influence of soil & climate interaction with the vines varies spatially.
• Climatic conditions, soil characteristics, topography, water availability are examples of interactive natural factors that vary spatially; management of irrigation, fertilisers, and crop load are examples of controllable factors that vary spatially.
• The proof of wine quality is in the bottle. The reasons for quality may be explored in the spatial information system.
Soil profile knowledge for spatial aspects
Precision Crop Monitoring using Unmanned Ground Vehicles
Structure of a ripe grape berry

- Pedicel
- Skin (exocarp)
- Cuticule
- Mesocarp
- Seed
- Endocarp
- Flesh
Maturity standards

• White varieties: TSS (°Brix)  
  Acidity  
  Juice recovery  
  Wine yield

• Red varieties: Above parameters including Colour
Sensory assessment of berries

- Berries tasting for sensory assessment
- The tasting includes berry firmness, colour, stalk removal, sweetness, acidity, juicing, skin strength, acidic, aroma, herbaceous, seed colour, seed number etc.
Harvesting methods

• Hand picking : More selective and qualitative

• Mechanical : Considerable hourly crop volume (4-10t/hr)

  Harvest is partially destemmed and crushed
Manual Harvesting: Best practice for quality wines
Grape Harvesters
Sugar reduction in juice

• Govts. In European countries are pressurizing for making of wines with low alcohol content
• Some members of OIV want only 2% alcohol in wines
• Wines without alcohol are also available in market with compromise on quality parameters
• Development of new prototypes to reduce sugar in juice
• Prototype has two type filters viz. ultra and nano separately
• UF allows sugar, acid and water and removes proteins, phenolics, heavy molecules
• In NF sugar and some proteins blocked and it allows water and acid only
• In next step filtrate of NF and suspended material blocked by UF mixed and juice ready without sugars
• As per requirement of alcohol in wines, the sugar added from available sugar
Alternative packaging and closures for wines

Closures

• Some problems are intact with cork closure viz.; cork taint, off flavours development (TCA and TBA) leakage and high price
• Screw caps are gaining high acceptance
• New closures are also coming in market like ZORK
• Screw caps lines Saran, Saranex Sarantin fill are working well
Packaging

• PET packaging has some advantages like non-breakable, recyclable, light in weight etc.
• Disadvantages are also such as permeability to O2 and CO2, acetaldehyde migrates etc.
• PET is available as multilayer, coating to minimizing O2 transport rate
• 496 g glass is required for making one 750 ml wine bottle while only 54g PET is required for same bottle
• Diamond Clear (O2 scavenger) is also available
• Tetrapack is well known to remove flavour compounds.
• Box in Bag is also popular in some countries.
Marketing: Issues and strategies
Consumption of wines... Global recent trend (per annum/person)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Countries</th>
<th>Amount</th>
</tr>
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<tbody>
<tr>
<td>#1</td>
<td>Italy</td>
<td>54 litres</td>
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<tr>
<td>#2</td>
<td>France</td>
<td>47 litres</td>
</tr>
<tr>
<td>#3</td>
<td>Switzerland</td>
<td>42 litres</td>
</tr>
<tr>
<td>#4</td>
<td>Austria</td>
<td>36 litres</td>
</tr>
<tr>
<td>#5</td>
<td>Denmark</td>
<td>32 litres</td>
</tr>
<tr>
<td>#6</td>
<td>Belgium</td>
<td>30 litres</td>
</tr>
<tr>
<td>#7</td>
<td>Germany</td>
<td>26 litres</td>
</tr>
<tr>
<td>#8</td>
<td>Australia</td>
<td>21 litres</td>
</tr>
<tr>
<td>=9</td>
<td>United Kingdom</td>
<td>20 litres</td>
</tr>
<tr>
<td>=9</td>
<td>Netherlands</td>
<td>20 litres</td>
</tr>
<tr>
<td>#11</td>
<td>New Zealand</td>
<td>19 litres</td>
</tr>
<tr>
<td>#12</td>
<td>Sweden</td>
<td>16 litres</td>
</tr>
<tr>
<td>#13</td>
<td>Ireland</td>
<td>13 litres</td>
</tr>
<tr>
<td>#14</td>
<td>Norway</td>
<td>11 litres</td>
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<tr>
<td>=15</td>
<td>Japan</td>
<td>10 litres</td>
</tr>
<tr>
<td>=15</td>
<td>Canada</td>
<td>10 litres</td>
</tr>
<tr>
<td>=15</td>
<td>Finland</td>
<td>10 litres</td>
</tr>
<tr>
<td>#18</td>
<td>United States</td>
<td>7 litres</td>
</tr>
</tbody>
</table>

Weighted average: 23.6 litres
Why people take wines

- **Socially acceptable** – In western countries socially acceptable. Food beverage in Maharashtra
- **Health benefits** - The health benefits of wine consumed in moderation relative to other forms of alcohol have become clearer in the past 5 years.
- **People want “experiences”** - Drinking wine is a sensory experience, like food, and wine offers a wide range of experiences based on different choices in grape types, regions, and wine-making styles.
- **Affordability** - Despite higher prices for collectible wine, wine is broadly affordable relative to other types of “experiences.”
- **Quality is up**
- **Greater purchasing access** - Access to a diverse selection of wine at competitive prices has been facilitated by the Internet and direct shipping.
- **Enjoyment factor** – creating an “enjoyment factor.” In general, wine has become part of many people's lifestyle.
- **Celebrity “endorsements”** - The “celebrity factor” has helped popularize wine, whether the celebrity is a winemaker (akin to celebrity chefs) or TV/movie celebrities profiled in Wine Spectator or other publications.
- **Consumption is growing rapidly** - Per capita wine consumption is on the rise
Health benefits of wines

• It is believed red wine is more beneficial than white
• Phenols and tannins has nuetraceutical impact on human health
• Due to presence of RESVERATROL it is beneficial in cardio problems
• Benefits have been recorded in sugar problems
• Good for eye sight
Recommendation:
Always take in limit

- 2.5 UK units per 187 ml bottle
- 1.7 UK units per 125 ml glass

UK Chief Medical Officers recommend adults do not regularly exceed:

- Men: 3-4 units daily
- Women: 2-3 units daily

Avoid alcohol if pregnant or trying to conceive
Various bottle sizes used for wine worldwide

- Regular
- Magnum
- Double Magnum
- Jeroboam
- Imperial
- Salmanazar
- Balthazar
- Nebuchadnezzar
## Wine Standards... BIS and OIV

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Characteristic</th>
<th>BIS</th>
<th>OIV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Dry White/Red</td>
<td>Sweet White/Red</td>
</tr>
<tr>
<td>1</td>
<td>Ethyl Alcohol (% by volume)</td>
<td>8 - 15.5 (±5)</td>
<td>8 - 15.5 (±5)</td>
</tr>
<tr>
<td>2</td>
<td>Free from unpleasant aroma, unpleasant test, cloudiness, sediments or suspended matters, mould and bacterial growth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Free from Ingredient injurious to health</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Color and Additives (except color) defined by PFA/CODEX/JECFA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Taste and Aroma: permitted under PFA/FEMA/GRAS may be used</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Reducing residual sugar, g/l</td>
<td>10 Max</td>
<td>10-150</td>
</tr>
<tr>
<td>7</td>
<td>pH</td>
<td>3.0-4.0</td>
<td>3.0-4.0</td>
</tr>
<tr>
<td>8</td>
<td>Total Acids (as tartaric acid), g/l, Max</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>9</td>
<td>Volatile Acidity expressed as acetic acid, g/l, Max</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>10</td>
<td>Esters as ethyl acetate (expressed in terms of grams per litre of absolute alcohol), Max</td>
<td>4.0</td>
<td>4.0</td>
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<tr>
<td>11</td>
<td>Higher Alcohol as amyl alcohol (expressed in terms of g/l of absolute alcohol), Max</td>
<td>4.0</td>
<td>4.0</td>
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<tr>
<td>12</td>
<td>Aldehydes as acetaldehyde (expressed)</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>No.</td>
<td>Parameter</td>
<td>Unit</td>
<td>Max 1</td>
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<td>-----------------------------------------------</td>
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</tr>
<tr>
<td>13</td>
<td>Total sulphur dioxide, mg/l, Max</td>
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<td>250</td>
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<tr>
<td>14</td>
<td>Free sulphur dioxide, mg/l, Max</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>15</td>
<td>Copper (as Cu), mg/l, Max</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>16</td>
<td>Iron (as Fe), mg/l, Max</td>
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<td>15</td>
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<tr>
<td>17</td>
<td>Extracts, g/l, Max</td>
<td></td>
<td>50</td>
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<tr>
<td>18</td>
<td>Tannins, g/l, Max</td>
<td></td>
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</tr>
<tr>
<td>19</td>
<td>Methyl alcohol (expressed in terms of g/l of absolute alcohol), Max</td>
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<td>2.0</td>
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<tr>
<td>20</td>
<td>Citric acid g/L</td>
<td></td>
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<tr>
<td>21</td>
<td>Arsenic mg/L</td>
<td></td>
<td>0.2</td>
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<tr>
<td>22</td>
<td>Boron mg/L (as Boric acid)</td>
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<td>80</td>
</tr>
<tr>
<td>23</td>
<td>Bromine mg/L</td>
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<tr>
<td>24</td>
<td>Cadmium mg/L</td>
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<td>0.01</td>
</tr>
<tr>
<td>25</td>
<td>Diethylene glycol mg/L</td>
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<tr>
<td>26</td>
<td>Malvidol diglucoside mg/L</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>27</td>
<td>Ethylene Glycol/Ethanediol</td>
<td></td>
<td>≤10</td>
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<tr>
<td>28</td>
<td>Fluoride mg/L</td>
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<td>1-3</td>
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<td>29</td>
<td>Ochratoxin A ug/L</td>
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<tr>
<td>30</td>
<td>Lead mg/L</td>
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<td>0.15</td>
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<tr>
<td>31</td>
<td>Propane -1-2-diol/propylene glycol mg/L</td>
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<td>150</td>
</tr>
<tr>
<td>32</td>
<td>Excess Sodium mg/L</td>
<td></td>
<td>60</td>
</tr>
<tr>
<td>33</td>
<td>Sulfate (express as potassium sulfate) gm/L</td>
<td></td>
<td>1-2.5</td>
</tr>
<tr>
<td>34</td>
<td>Zinc (mg/L)</td>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>
## European Wine Quality Standard

<table>
<thead>
<tr>
<th>No.</th>
<th>Special High Quality Wine (Cabinet)</th>
<th>High Quality Wine</th>
<th>Quality Wine</th>
<th>Country Wine (Vin Ordinaire)</th>
<th>Table Wine (blend, cuvee)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Alcohol (%)</td>
<td>&gt; 12.8%</td>
<td>&gt; 11.1%</td>
<td>&gt; 9.5%</td>
<td>&gt; 8.7%</td>
</tr>
<tr>
<td>2</td>
<td>Alcohol g/L</td>
<td>&gt; 215g/l</td>
<td>&gt; 88g/l</td>
<td>&gt; 85g/l</td>
<td>&gt; 70g/l</td>
</tr>
<tr>
<td>3</td>
<td>Sugar g/L</td>
<td>&gt; 102g/l</td>
<td>&gt; 188g/l</td>
<td>&gt; 181g/l</td>
<td>&gt; 150g/l</td>
</tr>
<tr>
<td>4</td>
<td>Baume</td>
<td>&gt; 12.4°</td>
<td>&gt; 11.1°</td>
<td>&gt; 10.7°</td>
<td>&gt; 9.1°</td>
</tr>
<tr>
<td>5</td>
<td>Brix</td>
<td>&gt; 22.3°</td>
<td>&gt; 20.0°</td>
<td>&gt; 19.4°</td>
<td>&gt; 16.3°</td>
</tr>
<tr>
<td>6</td>
<td>Specific Density</td>
<td>&gt; 1.094</td>
<td>&gt; 1.083</td>
<td>1.08</td>
<td>&gt; 1.067</td>
</tr>
<tr>
<td></td>
<td>(less than)</td>
<td>(less than)</td>
<td>(less than)</td>
<td>(less than)</td>
<td>(less than)</td>
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<tr>
<td>7</td>
<td>Free Sulphur dioxide</td>
<td>&lt; 70mg/l</td>
<td>&lt; 55mg/l</td>
<td>&lt; 60mg/l</td>
<td>&lt; 50mg/l</td>
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<tr>
<td>8</td>
<td>Total Sulphur dioxide</td>
<td>&lt; 350mg/l</td>
<td>&lt; 260mg/l</td>
<td>&lt; 300mg/l</td>
<td>&lt; 210mg/l</td>
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<tr>
<td>9</td>
<td>Content of Natural Acid</td>
<td>7g/l</td>
<td>7g/l</td>
<td>7g/l</td>
<td>7g/l</td>
</tr>
<tr>
<td>10</td>
<td>All grapes Originating from Same region and Same Kind</td>
<td>All grapes Originating from Same region and Same Kind</td>
<td>All grapes Originating from Same region and Same Kind</td>
<td>All grapes Originating from Same region and Same Kind</td>
<td>All grapes Originating from Same region and Same Kind</td>
</tr>
</tbody>
</table>
# SWOT analysis of Indian Wine Industries

## Strengths
- Indian wine consumption has grown 25-30% annually over a 5 year period.
- Good climate for grape growing
- Urban population is increasing.
- Youth are craving an alternative to hard liquors and developing a more refined taste.
- Wine is becoming more acceptable to women and youth.

## Weaknesses
- Wine remains an elite taste.
- Wine is difficult to store in India due to lack of cellars and refrigeration.
- Less than 50 percent of the population is legally old enough to drink (25 yrs. old).
- 400 million persons are 18 years old or younger.
- Poor awareness of wine and infrastructure.

## Opportunities
- 100 million persons will be legally allowed to drink alcohol (25 yrs. old) in the next 5 years.
- Supermarkets are emerging to support wine distribution infrastructure.
- Domestic market with increasing disposable income.
- Growing tourism industry.

## Threats
- The Indian constitution discourages alcohol consumption.
- Wine viewed as a “sin” by some.
- Indians still prefer whisky.
- Advertising for alcoholic beverages is banned.
- Domestic wine production is coddled by state governments.
## Indian Wine consumption - historical and projected

*(By volume)*

<table>
<thead>
<tr>
<th>YEAR</th>
<th>TOTAL</th>
<th>DOMESTIC</th>
<th>IMPORTED</th>
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<tbody>
<tr>
<td></td>
<td>(Number of 9 Liter cases)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>550,000</td>
<td>470,000</td>
<td>80,000</td>
</tr>
<tr>
<td>2005</td>
<td>620,000</td>
<td>520,000</td>
<td>100,000</td>
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<tr>
<td>2006</td>
<td>750,000</td>
<td>630,000</td>
<td>120,000</td>
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<tr>
<td>2007</td>
<td>900,000</td>
<td>750,000</td>
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<td>2008</td>
<td>1,100,000</td>
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<tr>
<td>2009</td>
<td>1,400,000</td>
<td>1,180,000</td>
<td>220,000</td>
</tr>
<tr>
<td>2010</td>
<td>1,700,000</td>
<td>1,440,000</td>
<td>260,000</td>
</tr>
<tr>
<td>2011</td>
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<td>2015</td>
<td>4,000,000</td>
<td>3,400,000</td>
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Wine consumption for 2008 by wine type (still wines)

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<th>Color</th>
<th>Domestic</th>
<th>Imports</th>
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<tr>
<td>Red</td>
<td>480,000</td>
<td>120,000</td>
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<tr>
<td>White</td>
<td>420,000</td>
<td>50,000</td>
<td>470,000</td>
</tr>
<tr>
<td>Rose</td>
<td>20,000</td>
<td>10,000</td>
<td>30,000</td>
</tr>
<tr>
<td>Total</td>
<td>920,000</td>
<td>180,000</td>
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Urgent need to design....

There are some sectors of the packaging industry where wine packaging need to improve. There is wastage of wine due to reaction against the climatic conditions.

The Points are :-

* When wine bottle is kept straight there is no contact between the cork and the bottle.

* As cork is made of a porous material due to loss in contact with wine and atmospheric heat the cork shrinks.

* Because of shrinking of cork the air comes inside the bottle.

* Oxygen present in the air reacts with wine to result in fermentation of wine.

* In fermentation Co2 is released.

* As atomic size of Co2 particle is higher the bottle burst open.
## Comparative data of MRLs (mg/L) for wines provided by different countries

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<th>Cd</th>
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</table>
50 samples on Indian wines were analyzed at NRCG. All samples comply BIS and other international standards. Heavy metal content in Indian wines does not represent a possible toxicological problem for human health.
Thanks... 

...for your attention!