

# Avocado

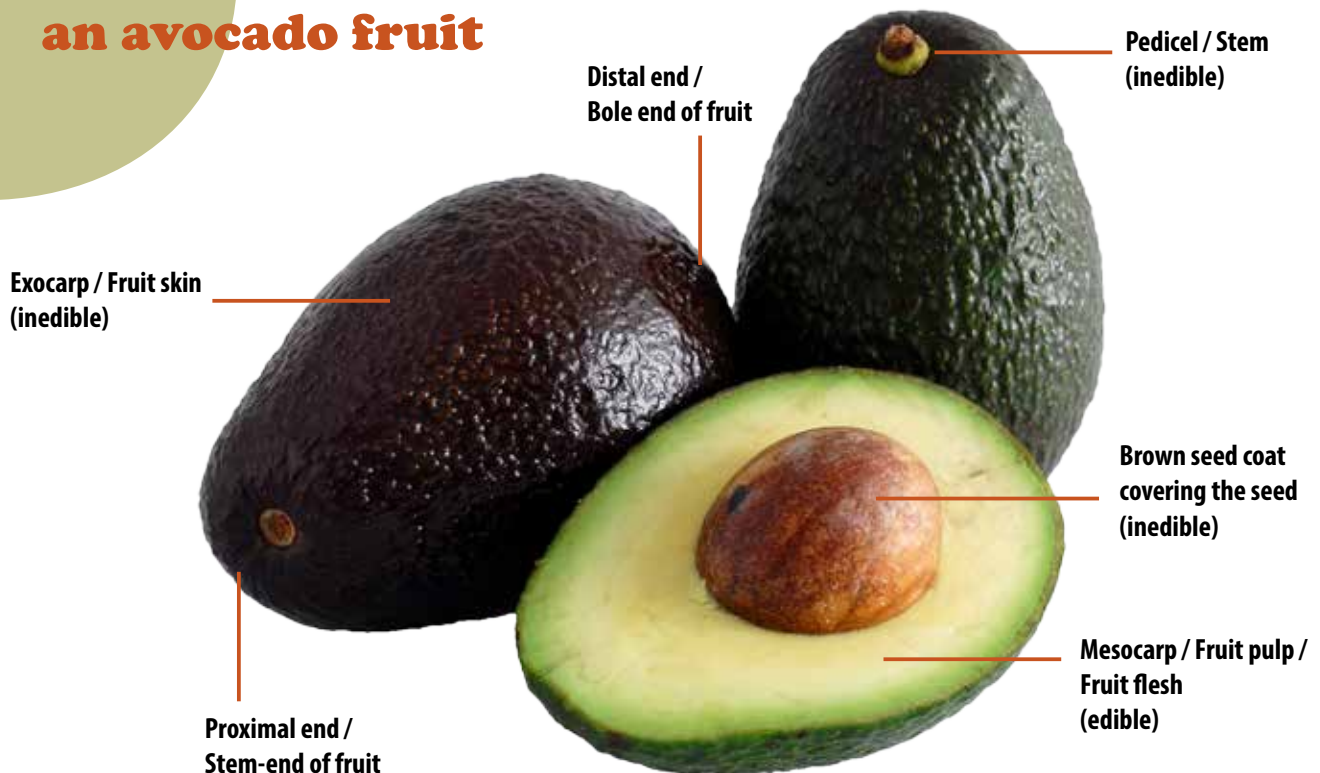
## Common Avocado Quality Defects

by **Richard Nelson**, [richard.nelson@sfr.fr](mailto:richard.nelson@sfr.fr)

*The purpose of this article is to describe and to provide background on some of the mostly commonly observed "defects" affecting avocados sold in Europe. This list is not exhaustive and excludes most cosmetic defects (including pest-related injuries), since fruits with such defects are usually visible and discarded at source.*

**D**ue to insufficient European production of avocados (mainly from Spain), the vast majority of the avocados sold in Europe are imported, and thus have to be transported long distances from their production areas. The time from orchard to European consumer outlet can be as short as a week to ten days (e.g. from Israel or Morocco) to a month or more (e.g. from Mexico, Kenya, Chile, South Africa, Peru). Refrigeration and other technologies such as controlled atmospheres are used to delay in-transit ripening. These are complex processes, and fruit quality can be negatively affected if the correct procedures have not been followed or if anything untoward happens. However, the root cause of many of the most common quality defects is often in the orchard, resulting in the fruits not being in optimal condition to be able to withstand long distance transport. Various quality defects have very similar appearances and are often incorrectly identified by European receivers. It is hoped that this article will assist the European Trade in correctly identifying some of the more common avocado quality defects.

### Anatomy of an avocado fruit



## Black or brown marks on fruit skin

A variety of phenomena can cause such marks on avocado skins, hence there being considerable confusion as to the correct identification of such defects. A common fault is to refer to all black marks as anthracnose infection, which is rarely the case, especially for unripe fruits.

### 1. Lenticel damage

Lenticels are the slightly raised pores on the surface of the skin of an avocado, which allow the fruit to “breathe”. Damage results in the blackening of the lenticels themselves, as well as in some instances, also the blackening of a small area of the skin immediately surrounding the individual lenticels caused by water loss through the damaged lenticels. These areas may also become more sensitive to low temperatures, resulting in the appearance of chilling injury symptoms (see point 2 below). The primary cause of damage to lenticels is rough handling during the picking or packing process. The susceptibility of the lenticels to damage is also sometimes increased by cold and wet weather during or immediately preceding harvest. Cold air flowing across the surface of the fruit (e.g. from a cold store’s refrigeration unit at the packing station) can also induce lenticel damage. It is incorrect and inaccurate to describe an avocado displaying such symptoms as “having too much lenticel”. All avocados possess lenticels, so one needs to specify that the lenticels have been damaged. The symptoms of lenticel damage can develop days to weeks after the fruits have been packed and deemed to be of satisfactory export quality. Lenticel damage may thus be considerably more pronounced upon reception in Europe. Avocado cultivars with thick / rough skins (e.g. Hass, Maluma) have more prominent lenticels, which are thus more prone to damage. However, for ripe fruits of such cultivars, the symptom is often barely visible due to the masking effect of the darkened skin. Lenticel damage is purely a cosmetic defect which does not affect eating quality. There is no concrete evidence that lenticel damaged fruits are more liable to develop secondary pathological infections.



Lenticel damage

### 2. Black Cold Injury

This is the term used by the South African avocado industry to refer to what is generally a post-harvest external chilling injury, characterised by shiny dark brown to black lesions / marks on the skin of the avocado, most commonly at or towards the bole-end of the fruit. The lesions are slightly sunken and have clearly defined edges. The symptom starts developing within a few days of packing, and is almost always visible immediately upon arrival in Europe. Black Cold Injury can occur on both hard and soft fruits, although receiving agents usually observe the symptom on fruits which have been delivered in a hard condition. The purple to black colour of the skin of ripe Hass (and other dark-skinned avocados) usually masks the symptom. The primary cause of Black Cold Injury is from avocados having been transported at inappropriately low temperatures, but there is also a risk that hard avocados can develop Black Cold Injury when stored under excessively cold conditions after European delivery. It is also important to note that it is not unusual to find that within the same consignment only fruits from certain growers have been affected



Black Cold Injury

**Black Sun Burn****Rubbing**

by Black Cold Injury. The most common cause for certain fruits being more prone to Black Cold Injury is fruit physiological immaturity at time of harvest. As avocados become more physiologically mature prior to harvest, their oil content increases and moisture content decreases, and in the process they become less susceptible to lower post-harvest temperatures. Larger avocados (e.g. Code Sizes 8,10,12,14) are more prone to post-harvest chilling injuries than is the case for smaller fruits. This partially explains why some avocado cultivars which tend to bear a higher percentage of larger fruits (e.g. Pinkerton, Edranol, Lamb Hass) are also more prone to Black Cold Injury. Tree condition as well as orchard nutritional imbalances can influence the susceptibility of avocados to Black Cold Injury, hence the differences between the fruit from different growers or orchards. In the overall majority of cases (especially for Fuerte and Hass avocados), the presence of a Black Cold Injury lesion on the exocarp of an avocado does not have an adverse effect on the internal / eating quality of the fruit, with the fruit pulp not being affected. However, it has been noted that some cultivars such as Pinkerton often develop secondary infections such as Anthracnose within regions of the fruit skin affected by Black Cold Injury lesions. Black Cold Injury lesions are post-harvest symptoms and are not caused by low orchard temperatures.

### 3. Black Sun Burn

In contrast to Black Cold Injury, black lesions caused by sunburn are not sunken – they may in fact be slightly raised. Black sunburn lesions are usually shinier in appearance than is the case for Black Cold Injury. A region of yellowed skin (“yellow sunburn”) sometimes surrounds black sunburn lesions. Black sunburn injury does not affect the eating quality of avocados.

### 4. Rubbing

Black discoloration as a result of sensitisation of the skin caused by rubbing during the picking or (more usually) the packing process. Symptoms can be virtually identical to Black Cold Injury. Black marks caused by rubbing are commonly found on the widest portion of the fruit, and where present it is common that more than one fruit per carton exhibits this cosmetic defect. Rubbing lesions have no effect upon internal quality.

### 5. Sooty Mould

Sooty Mould is often confused with external chilling injury symptoms. It is a naturally occurring fungus present in avocado orchards. These fungal infections can develop on

the fruit skin, most commonly at the pedicel end of a fruit, with streaks of the fungus running longitudinally down the fruit towards the bole. Sooty mould is light grey in colour and is generally removed during the washing process prior to packing. Such infections make fruits unsightly, but do not affect the internal eating quality of the avocado.

## 6. Anthracnose and Stem-end Rot

**Anthracnose** is the generic term to describe infections caused by fungi of the genus *Colletotrichum*. However, in avocado fruits, *Dothiorella* and other fungi can also be involved in secondary infections with similar appearance. Anthracnose commonly develops on over-ripe fruits and can also develop in transit. Early stages of Anthracnose infections are characterised by circular brown to black external lesions which may become sunken and exhibit a white fungal development in the centre of the lesion during the advanced stages of infection. Internally, infections penetrating the exocarp are characterised by a half-moon-shaped discoloration of the flesh.

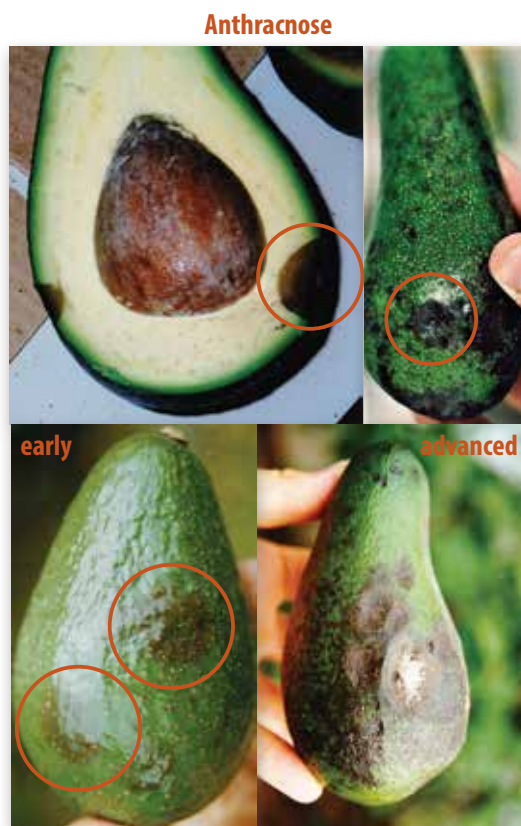
**Stem-end Rot** affects the pedicel end of the fruit and is often caused by the same fungi that cause anthracnose infections elsewhere on the fruit. Stem-end Rot is characterised externally by a blackening of the skin surrounding the stem ("pedicel") end of the fruit. The fungi enter the fruit via the cut end of the pedicel itself or other sites of injury caused to that part of the fruit during harvest (e.g. by clippers used to cut the fruit from the tree). Physiologically less mature fruits are far more likely to be affected by Stem-end Rot, one of the reasons being that less mature fruits take longer to ripen, which also allows the pathogen more time to develop. Stem-end Rot often also affects the vascular tissue, resulting in symptoms of vascular browning or blackening. When high percentages of this defect are noted, it is most likely that the fruits were under-mature when harvested. A high incidence of Stem-end Rot is also an indication of inadequate disease control in the orchard.

## 7. Carbon-dioxide poisoning / "Suffocation"

This occurs as a result of malfunction of a controlled atmosphere system, resulting in a build-up of carbon dioxide, causing suffocation of the fruit. External symptoms are similar to Black Cold Injury, but the lesions are considerably more sunken and generally



Sooty Mould



Anthracnose

Stem-end Rot





**Carbon-dioxide poisoning /  
"Suffocation"**

confined to the pedicel end of the fruit. Another difference compared with Black Cold lesions, is that suffocation lesions tend to be a dark "chocolate-brown" colour and shiny in appearance, whereas Black Cold lesions tend to be dull and dark-brown to black in colour. The severity of the internal disorders caused by carbon dioxide poisoning varies according to the extent and duration of the malfunction. Carbon dioxide poisoned avocados will usually not ripen properly or at all, and may be difficult to cut open. Flesh can be dried-out and grey to black. If symptoms of carbon dioxide poisoning are found in a container, it is extremely likely that all fruits in the container will be affected and will not ripen properly, even if some fruits do not display the characteristic external symptoms. Such fruit will not be of acceptable eating quality and ought to be destroyed. In more extreme cases, the symptoms are immediately apparent upon removal of the fruit from the container and an unpleasant odour may be noticeable when the container doors are opened. However, it is important to note that such symptoms can also develop 24 hours or more after the fruits have been removed from the modified atmosphere of the container. There is therefore always a risk that fruits which were judged to be sound upon reception, develop suffocation symptoms later on. It is thus important that consignments of avocados that are to be forwarded to a client by a receiving agent, should be subjected to an additional quality control, even if these fruits had already been identified as being of acceptable quality during standard reception procedures.

## Skin discoloration following prolonged refrigeration

It is sometimes noted – specifically for certain green-skinned avocados (e.g. Fuerte, Edranol), where the exocarp characteristically remains green upon ripening – that the exocarp acquires a brownish, unsightly tinge upon ripening. Such symptoms are far less common for dark-skinned cultivars and are often difficult to distinguish from the progressive skin colour change as the fruits ripens. Several years ago, the South African avocado industry identified, defined and named two such quality defects, which at the time were classified as chilling injuries – hence the (still used) terms Brown Cold Injury and Dusky Cold Injury for these symptoms.

### Brown Cold Injury

Brown Cold Injury is a brown discoloration of the avocado exocarp, the blemishes having defined but not sunken edges. The lenticels remain green and healthy

## About the Author:

**Richard Nelson** is an independent fruit quality assessor and consultant based in France. For more than two decades he was employed by the South African tropical fruit industry as their technical representative in Europe, monitoring fruit quality and identifying the causes of fruit quality problems. He has an extensive knowledge of the pre-harvest and post-harvest factors impacting upon avocado quality, and provides trouble-shooting services and guidance to the international avocado industry.

within the blemished area. Brown Cold is rarely seen on hard, unripe fruits. Far more commonly, the symptom develops when the fruits ripen under refrigeration, such as when transport times have been unusually long as a result of lengthy shipping delays, or following prolonged cold storage after arrival in Europe. The fruit flesh is normally unaffected when Brown Cold Injury symptoms are present, but such fruits are unattractive and unmarketable. It is unclear why certain avocados are more susceptible to Brown Cold Injury, but inappropriate refrigeration conditions are quite likely to be a contributing factor, in particular unacceptably low relative humidity levels in European cold-stores.

### Dusky Cold Injury

It is the author's belief that this quality defect is a more severe form of Brown Cold Injury, with internal quality commonly being affected. The symptom is a diffuse greyish-brown discoloration of the exocarp, which is usually confined to the distal (bole) end of the fruit upon ripening. The disorder is most common when avocados have been stored under refrigeration for an excessively long period of time and when they have ripened under refrigeration. Flesh discoloration is common for fruits displaying Dusky Cold Injury. The symptom is not distinguishable externally on ripened dark-skinned cultivars such as Hass.

### Internal Flesh Discoloration

### Grey Pulp

The most common such defect, and the only one that will be discussed in this article, is what is referred to by the South African avocado industry as Grey Pulp, also commonly referred to as Internal Browning and (less accurately) as Internal Chilling injury. This is characterised by grey or brownish discoloration of the fruit flesh and is more pronounced and thus more commonly observed in ripe fruits. A number of factors can contribute to the development of Grey Pulp in avocados, the most important of these being incorrect temperature management, prolonged cold-storage and, fruit physiological maturity. By far the most common cause of Grey Pulp is physiological over-maturity at time of harvest.

Fruits which were physiologically very-mature (not RIPE, since avocado fruits do not ripen on the tree) at the time of harvest, have a higher likelihood of developing Grey Pulp once the fruits ripen. Inappropriately low transit temperatures can play a role in the development of Grey Pulp, but it should be stressed that since lower transport temperatures are often used for end of season (i.e. physiologically very mature) fruits which would otherwise ripen more rapidly, in such cases the root cause is still physiological maturity. Fruits from some growers are known to be more susceptible to the disorder, probably related to nutritional factors. It is important to note that the temperature at which avocados are stored after arrival in Europe, as well as the length of time of that storage will greatly influence the incidence and degree of severity of Grey Pulp development ■

**Brown Cold Injury**



**Dusky Cold Injury**



**Grey Pulp**

