Preserving the Harvest Quality of Macadamia Nut-in-ShellCuring and Storage Regimes
澳洲坚果壳果品质研究：加工和储存方法

(The Lowest Common Denominators)
（最低共同标准）

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Dehydration technology and techniques are universally employed in agriculture and industry the world over. The broad outlines of the theories of thermodynamics and psychrometric's that are fundamental to dehydration are kinematic physics principles that are normally taught as part of an engineering course. The specific training that combines engineering and products is not usually available at academic institutions. Students requiring focused drying information on agricultural crops such as tobacco, vegetables, fruit and timber usually attend specialised training courses by non-institutional consultants and suppliers of equipment who also provide purposed designed literature.
脱水技术是世界各国农业和工业普遍采用的技术。热力学和干湿测量理论的广泛轮廓大纲是脱水的基础，而运动学物理原理通常是作为工程课程的一部分来教授。在学术机构，通常没有将工程和产品结合起来的特殊培训。需要集中了解烟草、蔬菜、水果和木材等农作物干燥信息的学生，通常会参加由非机构顾问和设备供应商提供的专门培训课程，他们还会提供专门设计的文献。

There are probably at least 50 different commercial macadamia cultivar types that are grown internationally and plant breeders are continually trying to increase tree yield and kernel quality by developing and selecting new and improved varieties. Each new cultivar produces macadamia nuts with new characteristics that may or may not be susceptible to the extremes of on-farm handling and processing. It is not possible, therefore, without expensive time consuming research, to establish the safe operating boundaries for each new cultivar nor is it practical or affordable for a farmer or the processor to have a specific storage vessel and regime to manage each cultivar type.
国际上大概至少有 50 种不同的商用澳洲坚果品种，植物育种家一直在努力通过开发和选择新的改良品种来提高树木产量和果仁质量。每一个新品种都能生产出具有新特性的澳洲坚果，这些特性可能受农场处理和加工的极端影响，也可能不受影响。因此，如果没有花费大量时间的研究，就不可能为每个新品种建立安全的操作边界，对于农民或加工者来说，具有特定的存储容器和管理每个新品种类型的方法是不切实际的或负担不起的。

The safe handling and management procedures that are necessary to preserve the quality of the macadamia nut require a sufficient understanding of the lowest common denominators that must be applied to all macadamia cultivars to prevent kernel deterioration. The design of any management system that requires the artificial manipulation of environmental and product parameters for heating, cooling, drying (curing) and storage must take into account the many thermodynamic, psychrometric and natural physics laws and principles that govern both the biotic and abiotic physical world. These lowest common denominators are the

determining factors that require that macadamias are cured (and not dried).
安全的处理和管理程序是保证坚果质量所必需的，这就需要充分了解必须应用于所有坚果品种以防止果仁退化的最低共同标准。任何需要人为控制加热、冷却、干燥(加工)和储存的环境和产品参数的管理系统的设计，都必须考虑到控制生物和非生物物理世界的许多热力学、湿度和自然物理定律和原则。这些最低共同标准是要求澳洲坚果是加工处理（而不是干燥）的决定因素。

Since …..
由于.....

- THE SHELF LIFE OF MACADAMIAS CANNOT BE SORTED
  澳洲坚果保质期无法区分

- THERE IS CURRENTLY NO STANDARD SHELF-LIFE TEST
  目前无标准的保质期测试方法

- THEREFORE THERE IS CURRENTLY NO 'SELL-BY' DATE
  因此目前无最迟销售日期

- CONSUMERS DO NOT HAVE STANDARD INDUSTRY ADVICE REGARDING RECOMMENDED STORAGE REGIMES OR PARAMETERS
  消费者没有关于推荐存储方法或参数的标准行业建议

Definitions:
定义：
Thermodynamics, Psychrometric's& Mechanics
热力学、湿度计和力学

(1) Thermodynamics
热力学

Thermodynamics is the study of heat and the thermal properties of matter. It is actually a study of the transformation of energy and of energy transfer from one system to another. Since natural processes often involve energy changes, the temperature plays the role of a label for these changes. Thermodynamics is interpreted on a molecular basis because the temperature of an object is directly related to the average kinetic energy of the atoms and molecules composing the object.
热力学是研究热量和物质热性质的学科。热力学实际上是研究能量的转换以及从一个系统到另一个系统的能量转移。由于自然过程常常涉及能量的变化，因此温度对这些变化起着重要作用。热力学是以分子为基础来解释的，因为一个物体的温度与组成该物体的原子和分子的平均动能直接相关。

The transfer of energy to or from a gas, liquid or solid may have multiple effects;
能量向气体、液体或固体之间的转移可能有多种影响;

1. change of temperature
   温变试验
2. expansion or contraction (linear and/or volume)
   膨胀或收缩（线性和/或体积）
3. change of viscosity
   粘度的变化
4. internal storage of energy (specific heat capacity)
   能量的内部储存（比热容）
5. phase change
   相变
6. chemistry change (reversible or non reversible)
   化学变化（可逆或不可逆）
7. creates a new source of energy transfer through conduction or radiation.
   通过传导或辐射创造能量转移的新来源。

Thermodynamics is governed essentially by two laws;
热力学本质上受两个定律支配；

- **1st Law** ***Law of Conservation of Energy***
  第一定律《能量守恒定律》
  Energy can change its form, but it cannot be created or destroyed
  能量可以改变形式，但不能被创造或摧毁。
- **2nd Law** ***Law of Degradation of Energy***
  第二定律《能量退化定律》
  Heat energy cannot be converted exactly to another form without loss.
  能量不可能完全转换成另一种形式而不损失。

(2) Psychrometric's
干湿测量

Psychrometric's is the science and practice of dealing with air mixtures and their control. The science deals with the specific heat of dry air and its volume with water vapour mixtures. It therefore also deals with the specific heat of water, the latent heat of vaporisation or condensation, and the specific heat of steam in reference to moisture mixed with dry air. Since air has weight, density, temperature, specific heat and heat conductivity, it therefore also has inertia and momentum as well as the ability to hold substances in suspension and in solution.
干湿测量是处理空气混合物及其控制的科学和实践。这门科学研究的是干空气的比热和其与水蒸气混合物的体积。因此，也涉及水的比热，蒸发或冷凝的潜热，以及水蒸气与干燥空气混合时的比热。由于空气具有重量、密度、温度、比热和热导率，因此它也具有惯性和动量以及在悬浮液和溶液中保持物质的能力。

Psychrometric's is best understood with the use of tables and graphs that have been developed to show the pressure, temperature, heat content (enthalpy), and volume of air and its steam content. The graphs also indicate dew point, actual water content

and relative humidity for varying conditions.
用图表来表示压力、温度、热含量（焓）、空气体积和蒸汽含量，可以很好地理解干湿测量法。图表还显示了不同条件下的露点、实际含水量和相对湿度

All life forms require water and air for survival. Life chemistry is always in contact with air and its water vapour. The temperature of the air will determine the direction
所有的生命形式都需要水和空气才能生存。生命化学总是与空气及其水蒸气接触。应记录环境空气温度。
and the rate of change of energy to an organism and its internal water activity. (Aw). The moisture vapour content of the air will determine whether hydration of the organism will be maintained of if dehydration will proceed.
以及生物体能量变化的速率及其内部水分活动。（Aw）空气中的湿气含量将决定如果进行脱水，是否将维持生物体的水合。

(3) Mechanics
力学

Mechanics is the study of the interactions between matter and the forces acting on it.
力学是研究物质和作用于其上的力之间相互作用的学科。

There are four branches of mechanics involving the macroscopic and/or microscopic forces on solids;
力学有四个分支，包括宏观力和/或微观力对固体的作用；

(1) **Statics** is broadly concerned with the action of forces when no change in momentum is involved. The forces are therefore balanced and the body is at a state of rest or unaccelerated motion.
静力学广泛关注的是没有动量变化时力的作用。因此，力是平衡的，物体处于静止或未加速运动的状态。

(2) **Dynamics** deals with cases in which there is a change in momentum.Bodies in motion have an attribute called inertia and are subject to Newton's Laws of Motion. The fundamentals of dynamics are mass, time interval and distance.
动力学研究的是动量发生变化的情况。运动中的物体有一个被称为惯性的属性，并且遵循牛顿运动定律。动力学的基本原理是质量、时间间隔和距离。
1st Law A body continues in a state of rest or uniform motion in a straight line unless it is acted upon by external forces.
第一定律 除受到外力的作用外，否则物体将继续处于静止或匀速直线运动的状态。
2nd Law The rate of change of a moving body is proportional to and in the same direction as the force acting on it. (F = ma)
第二定律 运动物体的变化率与作用在其上的力成正比，且方向相同。(F = ma)

3rd Law If one body exerts a force on another, there is an equal and opposite force, called a reaction, exerted on the first body by the second.
第三定律 一个物体对另一个物体施加力，第二个物体对第一个物体施加的力大小相等，方向相反，叫做反作用力。

(3) **Kinematics** is the study of the motion of bodies without reference to the forces affecting the motion. These forces are mostly concerned with the mechanism of chemical reactions under different conditions of temperature and pressure. Kinematics includes thermodynamics and psychrometric's.
运动学是研究物体运动而不考虑影响运动的力的学科。这些力主要与不同温度和压力条件下的化学反应机理有关。运动学包括热力学和干湿学。

(4) **Fluid Mechanics** is the study of the interaction between forces and fluids and includes three divisions;
流体力学是研究力与流体相互作用的学科，包括三个部分；

A. Hydrostatics is specifically concerned with the behaviour of liquids at rest.
流体静力学专门研究液体在静止状态下的行为。

B. Hydrodynamics examines the forces exerted on and by liquids and the motion that results from them.
流体动力学研究的是施加在液体上的力和液体引起的运动。

C. Aerodynamics examines the forces exerted on and by gasses and the motion that results from them.
空气动力学研究的是气体所施加的力以及气体所引起的运动。

The Natural Laws
生物自然法则

The natural physical laws – thermodynamics, hydraulics, psychrometric's, mechanics – that apply to the macadamia industry - have been divided into two groups; those that apply to pure engineering (group 1) and those that apply to the design of the nut (group 2).
自然物理定律——热力学、水力学、干湿学、力学——适用于澳洲坚果业——分为两类；适用于纯工程（第一组）和适用于坚果设计工程（第 2 组）

Research into varietal and post harvest improvement cannot be successful without the understanding and appropriate application of these laws.
对品种的研究和收获后的改良，如果没有理解和适当应用这些定律，是不可能成功的。

Group 1. Natural Physical Laws – Engineering
第 1 组自然物理法则-工程

The design of any management system that requires the artificial manipulation of environmental and product parameter for heating, cooling, drying (curing) and storage must take into account the following laws that govern both biotic and abiotic physical world.
任何需要人为操纵用于加热、冷却、干燥(加工)和储存的环境和产品参数的管理系统的设计，都必须考虑到以下控制生物和非生物物质世界的法则。

1. Latent heat (phase change energy)
潜热（相变能量）

1.1 Latent heat of water at 100 C is 2200kJ
100°C 时水的潜热为 2200kJ

1.2. Latent heat of water at 0 C is 484kJ
1.2.0°C 时水的潜热为 484kJ

2. Specific heat capacity Cp = kJ/kg/ K
比热容 Cp = kJ/kg/ K

2.1. Cp has different values for different substances
比热容（Cp）因物质不同而有不同的值

2.2 Cp of water is 4.169
水的比热容（Cp）是 4.169

2.3 Cp of ice is 2.089 (-10° to 0°C)
冰的比热容（Cp）是 2.089（-10 ℃～0℃）

2.4 Cp of water vapour is 1.963 (100° to 200°C)
水蒸气的比热容（Cp）是 1.963（100℃~200°C）

2.5 Cp of air is pressure dependent
空气的比热容（Cp）取决于压力

2.6 Cp of air is temperature dependent
空气的比热容（Cp）取决于温度

3. Energy absorption / radiation
能量吸收/辐射

3.1 Energy absorption/radiation is mass dependent
能量吸收/辐射取决于质量

3.2 Energy absorption/radiation is surface area dependent
能量吸收/辐射取决于表面积

3.3 Energy absorption/radiation is substance (Cp) dependent
能量吸收/辐射取决于物质（Cp）

3.4 Energy absorption/radiation is indicated by a change in temperature in unit time
能量吸收/辐射以单位时间内温度变化来表示

3.5 Energy absorption/radiation formula is Mass x Cp x T = Joules (J)
能量吸收/辐射式为质量×Cp× T =焦耳（J）

3.6 Rate of energy input per SI time unit S(second) = J/S = Watt (W)
每个 SI 时间单位的能量输入率 S（秒）= J / S =瓦特（W）

4. Heat energy transfer methods
热能传递方法

4.1. Radiation – heat energy travels at the speed of light in straight lines and is reflected by a mirror or other shiny surface
辐射–热能以光速直线传播，并被镜子或其他有光泽的表面反射。

4.2 Convection – heat energy is carried in an air stream as high energy air or vapour molecules
对流–热能以高能空气或蒸气分子的形式在包含在气流当中

4.3. Contact – heat energy is transferred by physical contact of one surface with another.
接触–热能通过一个表面与另一个表面的物理接触进行传递。

5. Temperature
温度

5.1 Temperature is an indicator of molecular activity
温度是分子活度的一个指标

5.2 Absorption of energy raises temperature and/or latent heat value
能量吸收会升高温度和/或潜热值

5.3 Temperature increase in the absence of surface water results in expansion
没有地表水时温度升高会导致膨胀

5.4 Temperature increase raises the activation energy of enzymes
温度升高会提高酶的活化能

5.5 Temperature values are an objective measure of chemical reactivity
温度值是化学反应性的一个客观性度量

6. Viscosity
粘度

6.1 Viscosity is a function of temperature in fluid mechanics
在流体力学中，粘度是温度的一个函数

6.2 Viscosity increases with a drop in temperature
粘度随温度降低而增加

6.3 Viscosity is lowered as temperature increases
粘度随温度升高而降低

7. Surface Tension
表面张力

7.1 Surface tension is function of temperature in fluid mechanics
表面张力是流体力学中温度的函数。

7.2 Surface tension increases with a drop in temperature
表面张力随温度下降而增加。

7.3 Surface tension is lowered as temperature increases
表面张力随着温度的升高而降低。

8. Vapour Pressure
蒸汽压力

8.1 Moisture molecules collide
水分分子碰撞

8.2 Trapped moisture molecules collide frequently = pressure
被锁住的水分分子经常碰撞=压力

8.3 Frequency of collision increases with energy absorption
碰撞频率随能量吸收而增加

8.4 Pressure and temperature are inter-related
压力和温度是相互关联的

8.5 Vapour pressure deficit determines moisture transfer
蒸汽压力不足决定了水分的流失

8.6 Vapour moves from area of pressure to area of deficit
蒸汽从压力区移动到不足区

9. Water activity Aw
水分活性 Aw

9.1 Aw occurs due to energy absorption by water molecules = vapour
Aw 是由于水分子吸收能量而产生的

9.2 Aw results in increased vapour pressure
Aw 导致蒸汽压升高。

9.3 Aw is a measure of drying potential
Aw 是干燥势的量度单位

9.4 Atmospheric vapour density is always 1.2kg/m³ (vapour rises above air)
大气水汽密度总是> 1.2 公斤/ m³(蒸汽高于空气)

10. Condensation
冷凝

10.1 Condensation occurs at dew-point
凝露发生在露点。

10.2 Condensation requires the presence of water vapour
凝结需要水蒸气的存在。

10.3 Condensate always contains dissolved air (therefore oxygen)
冷凝物总是含有溶解的空气(因此是氧)

10.4 Dew-point temperatures are indicated on altitude based psychrometric charts
露点温度用高度干湿图表示

11. Evaporative cooling
蒸发冷却

11.1 Energy is absorbed by moisture on bonding surface
能量被粘接在表面的水分吸收

11.2 Molecular bonding threshold of moisture is reached (see 1.1)
达到水分的分子结合阈值（见 1.1）

11.3 High energy water molecules escape bonding surface
高能量水分子从结合面流失。

11.4 Bonding surface loses energy (temperature)
结合面损失能量(温度)
11.5 Sustained escape of water molecules results in sustained cooling
水分子持续流失导致持续冷却

12. =Equilibrium moisture content EMC
平衡含水量 EMC

12.1 External vapour pressure = internal vapour pressure
外部蒸汽压=内部蒸汽压
12.2 Internal vapour pressure > external vapour pressure = moisture loss
内部蒸汽压>外部蒸汽压=水分损失
12.3 External vapour pressure < internal vapour pressure = moisture adsorption
外部蒸汽压<内部蒸汽压=吸湿
12.4 EMC values are product dependent
EMC 值取决于产品

13. Dynamic equilibrium moisture content
动态平衡含水量

13.1 Equilibrium changes with applied vapour pressure (relative humidity)
平衡随应用蒸汽压力(相对湿度) 的变化而变化
13.2 Equilibrium changes with temperature
平衡随温度变化
13.3 Product surface area affects rate of change in equilibrium
产品表面积影响平衡变化速率
13.4 Hydraulic pressure
液压
13.5. Vapour pressure
蒸汽压力
13.6 Diffusion
扩散
13.7 Moisture moves from high concentration to low concentration
水分由高浓度向低浓度移动
13.8. Moisture movement is dependent on cell structure
水分运动依赖于细胞结构
13.9 Moisture diffusion is time dependent
水分扩散与时间有关
13.10 Moisture diffusion is dependent on moisture differential
水分扩散依赖于水分差异
13.11 Moisture diffusion is related to travel distance
水分扩散与旅行距离有关
13.12 Moisture diffusion occurs more rapidly with elevated temperature
温度越高，水分扩散越快
13.13 Dissolution
溶解

13.14 Diurnal changes
日变化
13.15 Relative humidity
相对湿度
13.16 Mass x cp x temp = kJ
质量 x cp x 温度 = kJ
13.17 Solar heat absorption (albedo)
太阳能热吸收（反射率）
13.18. Shrinkage with drying
干燥收缩
13.19 Moisture escape precedes shrinkage
水分流失先于收缩
13.20 Shrinkage indicates volume reduction
收缩表示体积减小
13.21 Shrinkage occurs from outside
收缩发生在外部
13.22 Shrinkage retards further moisture loss (case hardening)
缩水率降低水分流失（表面硬化）
13.23 Air density with temp drop
空气密度随温度下降
13.24 Viscosity of oils
油的粘度

14. Psychrometric's
干湿测量

14.1 Storage temperature and relative humidity are important to shelf life
储存温度和相对湿度对保质期很重要。
14.2 Temperature of kernel storage should be 'cold chain' linked
果仁存储温度应与'冷链'连接
14.3 Lack of hygiene at all stages of curing can impact on the mechanics of curing
在加工的所有阶段缺乏卫生可能会影响加工的机制
14.4 Curing is weather dependent in open systems
在开放系统中，加工取决于天气
14.5 Curing is erratic without control
不控制，加工就不稳定。
14.6 Curing is expensive without control
不控制，加工就很贵。
14.7 Correct curing takes all cultivar types and volumes into account for all environmental conditions.
正确的加工要考虑到所有环境条件下的品种类型和产量。
14.8 Typical fluctuation of diurnal and nocturnal conditions.
昼夜条件的典型波动
14.9 Mechanics to reduce rewetting; fan size and batch height
力学减少再湿润；风扇尺寸和批量高度

14.10 Energy requirements for curing
加工的能量要求
14.11 Building integrity for curing systems
加工系统的建筑完整性
14.12 Moisture removal methods
除去水分的方法
14.13 Moisture retention and humidification methods.
保湿和加湿方法。
14.14 Storage temperature and relative humidity are important to shelf life
储存温度和相对湿度对保质期很重要。
14.15 Dew-point determines condensation to free moisture
露点决定凝结成自由水气。
14.16 Free moisture contains dissolved oxygen
游离水分含有溶解氧

15. Mechanical
机械

15.1 Force (N) = mass (kg) x velocity (m/s)
力(N) =质量（kg）x 速度（m/s）
15.2 Force (Pa) = N/area (m^2)
力（Pa） = N/面积（m^2）
15.3 Newtons Laws of Motion
牛顿运动定律

16. Hydraulics
水力学特性

16.1 Force is distributed equally in all directions
力均匀地分布在各个方向
16.2 Liquids are not compressible
液体是不可压缩的
16.3 Gasses are compressible
气体是可压缩的

Group 2. Natural Physics Laws - Horticulture
第 2 组 自然物理法则-园艺学

1. Cell structures and strengths of the different component parts of a macadamia nut vary with cultivar type (mechanical)
澳洲坚果的不同组成部分的细胞结构和强度随栽培种类型的不同而不同（机械）
2. Energy transfer in and through the nut occurs when the nut falls to the ground with impact (mechanical)
当坚果因撞击而掉落到地面时，发生在坚果内和通过坚果的能量传递（机械）

3. Impact force is determined by mass of nut and distance (velocity) of fall (mechanical).
   冲击力取决于坚果的质量和跌落距离（速度）（机械）。
4. The handling of macadamias introduces impact risk potential (mechanical)
   澳洲坚果的搬运会带来潜在的碰撞风险（机械）
5. Moisture storage by the exocarp (hydraulic)
   外果皮的水分储存（液压）
6. Exocarp provides impact absorption (mechanical)
   外果皮提供耐冲击性（机械）
7. NIH storage in the exocarp promotes metabolism = temperature increase and respiration vapour (thermodynamics).
   在外果皮中的壳果储存可促进新陈代谢=温度升高和呼吸蒸气（热力）。
8. Moisture absorption by the micropyle (Osmotic)
   珠孔吸收水分（渗透）
9. Swelling of the kernel (hydraulic)
   果仁膨胀（液压）
10. Swollen kernel becomes imprinted (discoloured) from applied pressure on pigmented inner seed-coat (hydraulic)
    在施加压力的情况下，膨胀的果仁会在有色内层种皮（液压）上留下印记（变色）
11. Rupturing of the testa for radicle(hydraulic)
    胚根种皮破裂（液压）
12. Kernel cell walls will rupture when impact threshold is reached (mechanical)
    达到碰撞阈值时，果仁细胞壁会破裂（机械）
13. Turgid cell walls will rupture at a lower impact threshold value (mechanical)
    肿胀的细胞壁会在较低碰撞阈值下破裂（机械）
14. Cell rupture may be micro or macro depending on impact force (mechanical)
    细胞破裂宏观或微观上都取决于碰撞力（机械）
15. Ruptured cells spill fluid contents that can flow (mechanical)
    破裂的细胞会溢出可流动的液体（机械）
16. Ruptured cells (bruising) expose spilt contents to free moisture and oxygen (mechanical).
    破裂的细胞（碰伤）使溢出的内容物暴露于自由水分和氧气中（机械的）。
17. Fluid contents of a mature kernel are 70% oil and viscous according to temperature (thermodynamics).
    根据温度（热力学），成熟果仁的流体含量为 70％的粘性油。
18. Oils will flow as they lose viscosity with an increase in temperature (thermodynamics)
    油会随着温度的升高失去粘度而流动（热力学）
19. Bruised kernels initiate rancidity (mechanical)
    碰伤的果仁会引发酸败（机械）
20. Rancidity development (oxidation of oils) rate is determined by temperature and moisture (thermodynamics)
    酸败度速率（油氧化）取决于温度和湿度（热力学）

21. Heat energy addition to the nut creates water activity Aw (thermodynamics)
    向坚果添加热能会产生水活度 Aw（热力学）
22. High albedo of the nut promotes temperature gain (thermodynamics)
    坚果的高反照率可促进温度升高（热力学）
23. Aw in the nut raises the vapour pressure differential (psychrometric's)
    坚果的水活度（Aw）会提高蒸气压差（温湿度）
24. Moisture loss causes kernel shrinkage (mechanical)
    水分损失导致果仁收缩（机械）
25. Moisture loss occurs via the pigmented (hilum end) of the NIS (mechanical)
    水分损失通过壳果（机械）的着色（种脐端）发生
26. Shrinkage of the kernel creates a space between the kernel and the seed-coat at the pigmented end of the NIS (mechanical)
    果仁收缩在果仁和壳果着色端的种皮之间形成空间（机械）
27. The airspace created in the NIS during moisture loss creates an air cushion which breaks the transfer of impact energy (mechanical).
    水分损失期间在壳果中形成的空域会形成气垫，从而破坏碰撞能的传递（机械）。
28. The kernel, during shrinking, remains attached to the seed-coat at the micropyle until shrinkage is complete and/or impact causes final separation (mechanical)
    在收缩过程中，果仁保持附着在珠孔的种皮上，直到收缩完成和/或碰撞导致最终分离（机械）
29. Moisture loss in the testa (seed-coat) precedes moisture loss in the kernel (mechanical)
    外种皮（种皮）中的水分损失先于果仁中的水分损失（机械）
30. Moisture loss in the kernel crust precedes moisture loss in the kernel core (mechanical)
    果仁皮中的水分损失先于果仁芯中的水分损失（机械性）
31. Moisture loss of unbound water in (immature) kernel cells precedes moisture loss from mature kernel cells.(hydraulic)
    未成熟果仁细胞中未结合水的水分损失先于成熟果仁细胞的水分损失。（水力学）
32. Moisture loss of unbound water requires less energy than bound water (thermodynamics)
    非结合水的水分损失需要的能量比结合水少（热力学）。
33. Moisture loss is time dependent for nuts of different diameters (mechanics)
    不同直径的坚果的水分损失随时间而变化（力学）
34. Moisture evaporation causes cooling (thermodynamics)
    水分蒸发导致冷却（热力学）
35. Evaporative cooling effect is dependent on air movement (thermodynamics)
    蒸发冷却效应与空气运动有关（热力学）
36. External shrinkage of the kernel results in crust stress (mechanics)
    果仁的外部收缩导致外壳应力（力学）
37. Evaporative cooling of the nut reduces the transfer of sensible heat internally to the nut (thermodynamics)
    坚果的蒸发冷却减少了内部显热对坚果的传递（热力学）

38. Excessive kernel drying causes cotyledon shrinkage and separation (mechanical)
过多的果仁干燥会导致子叶收缩和分离（机械性）
39. Kernel moisture retention promotes enzyme activity – discolouration (mechanical)
果仁水分保持促进酶活性-变色（机械性）
40. Kernel moisture retention promotes pre-germination (mechanical)
果仁水分保持促进发芽（机械性）
41. Kernel metabolism consumes stored energy and results in mass loss and cell deterioration (mechanical)
果仁新陈代谢消耗储存的能量，并导致质量损失和细胞退化（机械性）
42. Light in the presence of moisture and heat promotes pre-germination of NIS (mechanical)
光在湿热条件下促进 NIS 的萌发（机械性）
43. Low moisture content in kernel results in brittleness (mechanical)
果仁低含水量导致脆性（机械性）
44. Brittle kernel will chip or shatter depending on force of impact (mechanical) cracking
根据冲击(机械性)的力量，脆果仁会碎裂
45. High temperature and a high external vapour pressure will cause an increase in internal vapour pressure on the kernel of a wet NIS (thermodynamics).
温度和高的外部蒸汽压力会导致湿态 NIS（热力学）果仁的内部蒸汽压力增加。
46. Kernel cell walls can be ruptured by high vapour pressure (thermodynamics).
高蒸气压（热力学）可使果仁细胞壁破裂。
47. Kernel cell contents can be congealed (cooked) by high temperatures (thermodynamics)
果仁细胞含量可通过高温（热力学）凝结（煮）
48. Moisture loss from the kernel during high NIS Aw and low external vapour pressure is continuous away from the NIS (psychrometric's)
在高 NIS Aw 和低外部蒸汽压期间，果仁的水分损失与 NIS（湿度测量系统）之间是连续的。
49. NIS that are allowed to cool below the drying temperature will absorb external air back into the NIS (psychrometric's).
温度低于干燥温度的 NIS 会将外部空气吸收回 NIS（湿度测量仪）。
50. Dehydrated macadamias are hygroscopic (mechanical).
脱水的澳洲坚果是吸湿的（机械性）。
51. Forced air with a higher vapour pressure than the inter-granular vapour pressure of bulk NIS will rewet the NIS (psychrometric's)
蒸汽压比散装 NIS 的粒间蒸汽压高的加压气流，会使 NIS（干湿测量系统）重新湿润。
52. The moisture in absorbed air will condense in the space between and on the kernel and inner seed coat if dew point is reached (psychrometric's).
如果达到露点（湿度），被吸收的空气中的水分就会在籽粒和种皮之间以及籽粒内部凝结（干湿测量系统）。
53. Dissolved oxygen together with the introduced condensate will promote enzymatic discolouration of the kernel and/or the increase in the rate of rancidity where spilt oil is exposed (thermodynamics)

溶解氧和引入的冷凝物将促进核的酶变色和/或溢出的油暴露时的酸败率的增加(热力学)

54. Free moisture (condensate) in the presence of high humidity and an ideal temperature will promote the germination of fungal spores (thermodynamics)
    高湿度和理想温度下的游离水分（冷凝物）会促进真菌孢子的萌发（热力学）
55. The energy and time required to evaporate the condensate is equal to an equal amount of water evaporated during NIS dehydration (thermodynamics).
    蒸发冷凝水所需的能量和时间等于在 NIS 脱水过程中蒸发的等量水（热力学）。
56. Different cultivars react differently over time to different temperature and storage regimes (thermodynamics)
    随着时间的推移，不同的品种对不同的温度和贮藏状态的反应也不同（热力学）
57. Reduced temperature slows metabolic rate and increases shelf life (thermodynamics)
    降低温度会减慢新陈代谢速度并延长保质期（热力学）
58. Reduced temperature increases oil viscosity and retards exposure to atmosphere (thermodynamics)
    降低温度会减慢新陈代谢速度并延长保质期（热力学）
59. Removal of oxygen (replacement with nitrogen) slows metabolism and rate of rancidity (mechanical)
    除去氧（用氮代替）会减慢新陈代谢和酸败率（机械性）
60. Macadamias are food energy source and are not sufficiently mechanically protected to prevent loss from vermin, bush pigs, etc.
    澳洲坚果是食物的能量来源，没有足够的机械保护，来防止害虫、灌木猪等造成的损失。

Limitations to quality preservation
保鲜的局限性

The general phenological pattern of the 50 plus cultivar varieties of macadamia does not vary much, but individual cultivar characteristics may have significant differences due to cultural practices, climate, altitude and latitude. Plant breeders continue to develop new cultivars in search for a disease and insect resistant macadamia tree that also produces a high yield of quality nuts with secure, thin shells. The ideal macadamia tree should also produce consistently in spite of temperature extremes. Plant breeders have not yet bred this ideal tree, but the present multitude of accepted cultivars has provided for macadamias that have a great number of physiological differences between their different seeds. These differences include;

澳洲坚果 50 多个品种的一般物候模式变化不大，但是由于栽培习俗、气候、海拔和纬度，个别品种的物候特征可能会有显着差异。植物育种家继续开发新的品种，以寻找一种抗病和抗虫的澳洲坚果树，这种树还可以生产出高产、安全、薄壳的优质坚果。理想的澳洲坚果树也应该在极端温度的情况下持续生长。植物育种家还没有培育出这种理想的树，但目前众多被公认的品种为澳洲坚果提供了不同种子之间大量的生理差异。这些差异包括；

1. seed size
   种子大小
2. abscission potential
   脱落潜力
3. husk thickness
   外壳厚度
4. shell thickness
   壳壁厚度
5. shell porosity (fiber density)
   壳壁孔隙率（纤维密度）
6. cotyledon binding mechanism (strength)
   子叶结合机制（强度）
7. kernel size
   果仁尺寸
8. kernel moisture content
   果仁含水量
9. kernel cell wall thickness
   果仁细胞壁厚度
10. oil content
    含油量
11. sugar content
    含糖量
12. roasting potential
    焙烧潜力
13. moisture content
    含水量
14. potential for water absorption
    吸水潜力
15. potential for discolouration
    变色潜力
16. moisture diffusion (between cells)
    水分扩散（细胞之间）
17. shrinkage rate and ratio
    收缩率及比例
18. Enzymatic potential
    酶的潜力
19. maturity at harvest
    采收季成熟

These differences may be exacerbated negatively by the
这些差异可能会因以下负面影响而加剧

1. time taken to bring in the harvest,
   收获所需的时间，

2. the climatic conditions that prevail at harvest and the
   在收获季节普遍存在的气候条件以及
3. methods employed to physically effect the harvest.
   实际影响收获使用的方法

Examples of the generalised causes of loss that may be in combination and exaggerated due to exacerbating circumstances are;
由于加剧的情况，可能造成综合和夸大的一般损失原因的例子如下：

1. over maturity (late harvest and/or abscission stick-tights)
   过度成熟（晚收和/或脱落鬼针草）
2. immaturity (mechanical or chemical intervention premature)
   不成熟（机械或化学干预过早）
3. enzymatic discolouration of kernel (long available reaction time)
   果仁的酶变色（较长的可用反应时间）
4. distal end discolouration and onion ring (time/moisture combination)
   远端变色和洋葱环（时间/水分结合）
5. loss of crispness (excessive respiration time / high moisture content)
   松脆度下降（呼吸时间过长/水分含量高）
6. mould (susceptibility in damp conditions - rain)
   霉菌（潮湿条件下的易受影响-雨天）
7. heat damage (exposure to sun and other energy sources)
   热损伤（暴露于阳光和其他能源下）
8. bruising (due to rough handling or hail)
   擦伤（由于粗暴处理或冰雹）
9. insect damage (susceptibility of selected cultivar)
   病虫害（选育品种的敏感性）

The search for macadamia utopia drives researchers to investigate many avenues that attempts to establish the horticultural and physiological causes of kernel defects such as browning, discolouration, brown-centring, brittleness, wrinkled kernel, split kernel, glassiness, rancidity and short shelf-life.
对澳洲坚果乌托邦的探索驱使研究人员调查了许多途径，以找出造成果仁缺陷的园艺和生理原因，例如褐变、变色、褐心、脆化、皱仁、裂仁、玻璃化、酸败和保质期短。

While many of these defects may have a genetic predisposition, the more important causes may combinations of thermodynamic, psychrometric and mechanical effects brought about by poor handling by unwitting operators or by the excesses of poorly designed equipment.
虽然这些缺陷中的许多可能具有遗传倾向，但更重要的原因可能是由不知情的操作者的不当操作或设计不良的设备的过度使用所带来的热力、湿度和机械效应的组合造成的。

Post-harvest Handling
采收后处理

The visual sorting of aesthetically displeasing nuts prior to packaging is essential, but is NOT quality sorting!!
在包装之前，对视觉外观不佳的坚果进行目视分类至关重要，但不是质量分类！！

Every step of the post - harvest handling of macadamias prior to packaging is of paramount importance to the preservation of quality kernels with high market value.
在包装之前，澳洲坚果采收后处理的每一步对于保持具有高市场价值的优质果仁至关重要。

Every post-harvest step has a lowest common denominator that should not be exceeded.
采收后每一步都有一个最低的共同标准，不应超过此标准。

The greatest impact on the loss of quality, value and long-term shelf-life is the non-adherence by growers and processors who, unknowingly or uncaringly, exceed the lowest common denominators that impact negatively on shelf-life ….
对质量、价值和长储存期限损失的最大影响是种植者和加工者的不遵从性，他们在不知不觉中或毫不在意地超过了对储存期限产生负面影响的最低共同标准……

1. Harvest response time (too early before maturity or too long after abscission.
   采收响应时间（成熟前过早或脱落后过长。

2. Harsh mechanical handling
   粗暴的机械操作

3. Poor dehydration techniques
   较差的脱水技术

4. Risky storage conditions
   危险的储存条件

Specifically, the removal of moisture from the macadamias using carefully controlled curing parameters is necessary to preserve their harvest quality, large styles and and extended shelf-life.
特别是，必须使用精心控制的加工参数从澳洲坚果中除去水分，以保持其采收质量、大尺寸和延长的储存期限。

Storage system parameters for both NIS and processed kernel must be appropriate and precisely controlled to maintain the shelf-life of their harvest quality.
壳果和加工果仁的存储系统参数必须适当且精确控制，以保持其采收质量的储存期限。

Dehydration – thermodynamics and psychrometric's
脱水–热力学和湿度测定

The dehydration of macadamias is a thermodynamic process where heat energy is transferred and moisture removed by means of psychrometric principles.
澳洲坚果的脱水是一个热力学过程，在该过程中，通过湿度测定原理传递热能并去除水分。

1. moisture absorption causes swelling from micropyle towards the hilum
   水分吸收会导致从珠孔向核膨胀
2. moisture loss causes shrinking through vascular tissue
   水分流失导致维管组织收缩
3. moisture loss from immature nuts causes shrinking on hilum hemisphere
   未成熟坚果的水分流失会导致核的半球收缩
4. rapid moisture loss causes shrinkage & stress on the crust
   快速水分流失会导致外壳收缩和应力
5. rapid moisture loss causes evaporative cooling (no Aw) internally = no drying (reducing sugars at centre especially in large kernels)
   水分快速流失导致内部蒸发冷却（无 Aw） =不干燥（尤其是大粒果仁的中心处糖分减少）
6. excessive and rapid drying causes cotyledon shrinkage (half kernels)
   过度和快速干燥会导致子叶收缩（半粒）
7. delayed drying promotes rancidity
   延迟干燥会导致酸败
8. delayed drying in the presence of ideal temperature promotes pre-germination
   在理想温度下延迟干燥会促进发芽
9. storage of bulk NIH creates high temperature and high humidity conditions resulting in runaway metabolism
   大量 NIH 的储存会产生高温和高湿度条件，导致新陈代谢失控
10. Excess and untimely light together with moisture and sufficient heat promotes pre-germination
    过多和不合时宜的光照以及水分和足够的热量促进发芽
11. Excess moisture promotes bruising during rough handling
    在粗糙的处理过程中，过多的水分会导致擦伤
12. Over drying promotes brittleness and shattering during cracking
    过度干燥会导致开裂时的脆性和破碎
13. High temperature promotes high internal vapour pressure on kernel = cell rupturing damage
    高温会在果仁上产生较高的内部蒸气压=细胞破裂损伤
14. Temperature promotes low viscosity of oil causing flow of especially damaged cells
    温度促进油的低粘度，造成特别是受损细胞的流动
15. Shrinkage causes space at hilum end first
    收缩首先导致种脐端空隙

16. Cooling during drying causes condensation droplets in internal space = discolouration
    干燥过程中的冷却导致内部空间的凝结水滴=变色
17. Cooling with wet air causes moisture absorption in the shell and adsorption on the kernel = exacerbates discolouration
    用湿空气冷却会导致壳吸收水分，并吸附在果仁上=加剧变色
18. Condensation droplets contain dissolved oxygen, which promotes enzyme discolouration activity and rancidity of damaged nut. Also mould.
    冷凝液滴中含有溶解氧，这会促进酶的变色活性和受损坚果的酸败。也发霉。
19. The passing of time exacerbates extent of damage and perceived chemical changes according to the cultivar type.
    随着时间的推移，根据品种类型引起的损害程度和感知的化学变化加剧。
20. Storage temperature and relative humidity are important to shelf life
    储存温度和相对湿度对保质期很重要。
21. Temperature of kernel storage should be 'cold chain' linked
    果仁存储温度应与'冷链'连接
22. Lack of hygiene at all stages of curing can impact on the mechanics of curing
    在加工的所有阶段缺乏卫生可能会影响加工的机制
23. Curing is weather dependent in open systems
    在开放系统中，加工取决于天气
24. Curing is erratic without control
    不控制，加工就不稳定。
25. Curing is expensive without control
    不控制，加工就很昂贵。
26. Correct curing takes all cultivar types and volumes into account for all environmental conditions.
    正确的加工要考虑到所有环境条件下的品种类型和产量。
27. Typical fluctuation of diurnal and nocturnal conditions.
    昼夜条件的典型波动
28. Mechanics to reduce rewetting; fan size and batch height
    减少再湿润机制；风扇尺寸和批次高度
29. Energy requirements for curing
    加工的能量要求
30. Building integrity for curing systems
    加工系统的建筑完整性
31. Moisture removal methods
    除去水分的方法
32. Moisture retention and humidification methods.
    保湿和加湿方法。

The removal of moisture from the macadamia to controlled limits is therefore necessary to preserve its harvest quality. The dehydration process must, however, be managed with care if the quality and shelf-life of the macadamias are to be preserved.
因此，将澳洲坚果中的水分去除至可控制的限度是保持其收获质量是必要条件。但是，如果要保留澳洲坚果的品质和保质期，脱水过程必须小心管理。

The term **'drying'** implies i) without regard to temperature or temperature limits, ii) without specific regard to air relative humidity and speed iii) and without regard to time.
术语"干燥"是指 i）不考虑温度或温度限制，ii）不特别考虑空气相对湿度和速度 iii）也不考虑时间。

'Curing' is the correct term for moisture removal from macadamias because it implies that moisture is removed under continuous and controlled conditions.
"加工"是从澳洲坚果中脱水的正确术语，因为它意味着在连续且受控的条件下脱水。

The controlled condition parameters are described under the heading – 'Do's and Don't's'.
所控制的条件参数在"应做和不应做"的标题下说明。

There are several thermodynamic reasons that macadamias should not simple be dried, but rather cured. (see Figure 1. EMC Curves)
有多种热力学原因，澳洲坚果不应简单干燥，而应加工。（见图 1。EMC 曲线）

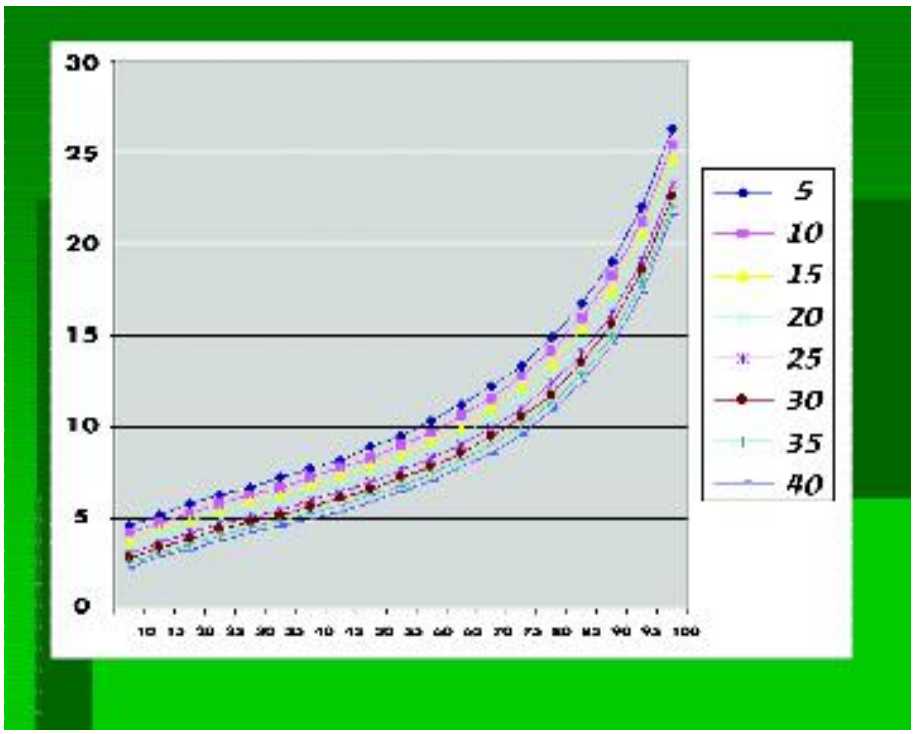

Figure 1. EMC Curves
图 1. EMC 曲线

1. Moisture cannot escape the kernel until the shell is sufficiently porous (dry). This is time dependent and relates to the thickness of the shell.
直到外壳足够多孔（干燥），水分才能离开果仁。这与时间有关，且与壳层的厚度有关。

2. Heat energy cannot reach the kernel to create water activity (Aw) while moisture loss from the shell provides evaporative cooling. If heat energy is added faster than the

evaporation rate then there will be a net increase in vapour pressure in the kernel creating a 'pressure cooker' effect that can damage kernel cells.
热能无法到达果仁以产生水活度（Aw），而壳中的水分损失会提供蒸发冷却。如果热能的增加速度快于蒸发速率，那么果仁中的蒸气压就会净增加，从而产生"压力锅"效应，从而损坏果仁细胞。

3. Moisture loss from the kernel is by diffusion beginning from the outside and progressing inward. This time dependent and relates to the size (diameter) of the kernel. The kernel must be dry to its core to ensure that metabolism ceases completely and that reducing sugars are not formed. Sugars formed by incomplete drying – especially noticeable in larger kernels – will caramelise forming brown centres during roasting.
果仁的脱水是从外部开始向内扩散。这与时间有关，且与壳层的厚度有关。果仁必须干燥至其核心，以确保新陈代谢完全停止，并且不形成还原糖。不完全干燥形成的糖 - 特别是在较大的果仁中特别明显 - 将在烘烤过程中焦糖化形成褐心。

4. Raised temperature lowers the viscosity of the oil and also predisposes it to chemical change (oxidation = rancidity).
升高的温度降低了油的粘度，也使油易于发生化学变化（氧化=酸败）。
5. Raised temperature promotes increased metabolism that leads to quality deterioration with increasing time.
温度升高促进新陈代谢的增加，从而导致质量随着时间的增加而下降。
6. Excessive drying rate (air speed and/or temperature too high) will cause rapid shrinkage of the kernel crust resulting in stress cracks (cell tearing = exposed oil) as well as predisposing the kernel to shattering during the cracking process.
干燥速率过高（空气速度和/或温度过高）将导致仁壳迅速收缩，从而导致应力裂纹（细胞撕裂=裸露的油），并使仁粒在开裂过程中容易破碎。

7. Moisture removal should be continuous with a constant net movement of moisture away from the kernel until the desired moisture content is reached. The regular stop/start of moisture removal (as in ambient air drying) results in the cooling of the nut and a reversal of the direction of wet air flow. Moisture that is re-introduced to the kernel may condense on its surface as fine droplets that contain dissolved oxygen. The combination of oxygen, moisture and temperature provides for enzymatic discolouration, oxidation of oil and the germination of fungal spores.
脱水应连续进行，水分不断地从果仁中移出，直至达到所需的水分含量。定期停止/开始除湿（如在环境空气干燥）会导致坚果冷却并改变湿空气流动的方向。重新进入果仁的水分可能会凝结成含有溶解氧的细小液滴。氧气、水分和温度的结合会导致酶变色，油类氧化和真菌孢子萌发。

   Stop/start drying also increases the time it takes to remove moisture and increases the risk to quality.
   停止/开始干燥还会增加脱水所需的时间，并增加质量风险。

8. Shrinkage of the kernel is time dependent. Even and constant shrinkage ensures that the kernel separates from the inner shell without damage leaving the kernel cuticle intact.
果仁的收缩与时间有关。均匀而持续的收缩确保了果仁与内壳分离而不会受到损害，而使果仁表皮保持完整。

9. Curing controls the relationship (ratio) of kernel to shell moisture that determines the whole kernel recovery potential during cracking. Optimum whole kernel recovery is obtained when the NIS moisture content is 5.5% and the ratio of shell to kernel moisture is between 1:2.4 and 1:3.5 (Hobson). Rapid drying i.e. high temperature drying especially at increased air velocities - increases this ratio accordingly.
加工控制了果仁与壳层水分的关系（比率），该关系决定了开裂过程中整个果仁的恢复潜力。当 NIS 含水量为 5.5％，壳与果仁水分的比例在 1：2.4 和 1：3.5 之间时（霍布森），可获得最佳的整粒回收率。快速干燥，即高温干燥，尤其是在增加空气速度的情况下-相应地增加了该比率。

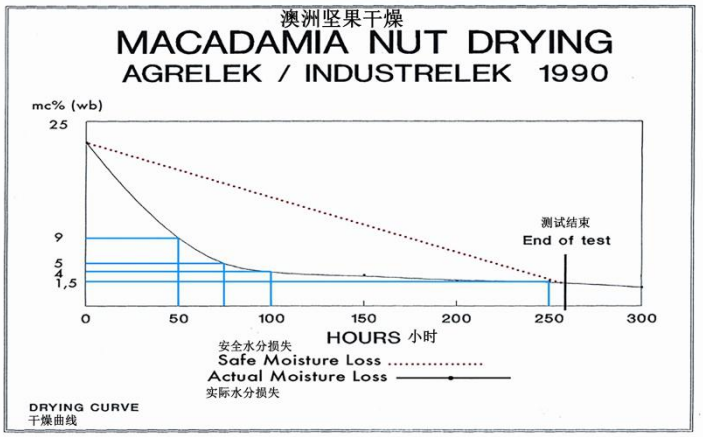

Figure 2. Optimal Curing Time
图 2 最佳加工时间

NIS 25% -11% @ 2% /day moisture removal - 5 days
NIS 25％-11％@ 2％/天脱水-5 天
NIS 11% - 6% (kernel 1.5%) @ 1% /day moisture removal - 5 days
NIS 11% - 6% （果仁 1.5%）@ 1% 天脱水-5 天

Whole kernels
完整果仁

The mass recovery of kernel from NIS uses a violent cracking process that shatters the shells at random. Kernel that is over dry, that have stress cracks or that are still too wet (kernel attached tightly to the shell) will break or shatter with the shell. Any breakage of the kernel whatsoever will result in oil spill and the unavoidable potential for oxidation. Kernels that dehydrated sufficiently and that have shrunk evenly are protected by an air cushion during cracking and experience less direct impact. Macadamias that have been harvested at optimum maturity in dry ambient conditions, handled without bruising and cured within correct thermodynamic limits have the best chance of being removed from the shell as whole kernel

with its cuticle intact.
从 NIS 大量回收果仁的过程是一个剧烈的开裂过程，该过程会随机破坏外壳。过度干燥、有应力裂纹或仍然太湿（果仁紧密地附着在外壳上）的果仁将破碎或随着外壳粉碎。果仁的任何破裂都会导致溢油和不可避免的潜在氧化。充分脱水且收缩均匀的果仁在开裂过程中受到气垫的保护，受到的直接冲击较小。在干燥的环境条件下以最佳成熟度收获的澳洲坚果，在没有碰伤的情况下处理，并在正确的热力学极限下加工，最有可能从壳中表皮完整的取出整个果仁。

Undamaged whole kernels have the best chance to achieve a long shelf-life.
未损坏的整个果仁最有可能获得较长的保质期。

Discerning buyers of smaller kernel styles who require a long-shelf life are advised to buy whole kernel that can be diced according to choice just prior to value adding.
对于需要较长保质期的较小果仁风格的挑剔买家，建议在增加价值之前根据选择购买整个果仁。

Storage
储存

Damaged kernel that is subject to warm, moist ambient conditions are at great risk from oxidation and an unacceptable short shelf-life. Storage techniques that are based on thermodynamic principles have, however, provided the macadamia industry with a measure of shelf-life security in spite of the many shortcomings in the post-harvest handling and curing methods.
在温暖、潮湿的环境条件下，受损的果仁存在可能被氧化、保质期也很短的风险。尽管收获后的处理和加工方法存在许多缺点，但基于热力学原理的存储技术已为澳洲坚果产业提供了一定的保质期。

The key management interventions that will arrest the irrevocable oxidation process initiated on damaged kernel caused during cracking are;
关键的管理干预措施将阻止在开裂过程中对受损籽粒引发的不可逆转的氧化过程，包括：

1. ensuring high viscosity of the oil during cracking and sorting i.e. lowest practical NIS and ambient temperatures.
   确保开裂和分选过程中油的高粘度，即最低的实际 NIS 温度和环境温度。

2. packaging environment must be dry i.e. hygroscopic kernel are not exposed to ambient moisture.
   包装环境必须干燥，即吸湿籽粒不暴露于环境湿度。

3. vacuum packaging followed by nitrogen flushing i.e. oxidation potential reduced.
   真空包装后进行氮气冲洗，即氧化电势降低。

4. quality packaging material of sufficient micron thickness. i.e. zero potential of gaseous exchange with ambient air (oxygen).
足够微米厚的优质包装材料，即与环境空气（氧气）气体交换的零电势。

5. speedy process from kernel exposure at cracking to containment in safe packaging i.e. hours – not days.
从开裂时的籽粒暴露到安全包装中的密封的快速过程，即几小时，而不是几天。

6. reduced temperature during storage and transport until consumption i.e. the chemical reactions causing oxidation and enzyme activity are retarded.
在消耗前储存和运输期间温度降低，即导致氧化和酶活性的化学反应被延迟。

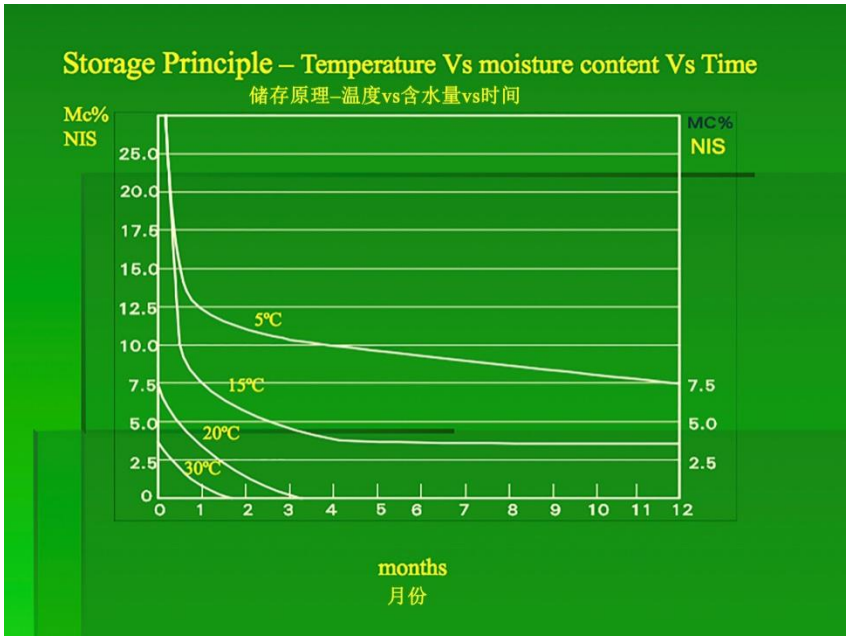

Figure 3. Safe Storage Temperatures
图 3 安全存储温度

The Lowest Common Denominators
最低共同标准

Macadamia quality preservation is inextricably linked to the laws of physics that both govern the horticulture of cultivar selection and growth and the mechanics of the equipment selected for handling and management.
澳洲坚果的品质保持与管理栽培种选择和生长园艺以及选用于处理和管理的方法和设备力学的物理法则密不可分。

The common defects found in the kernels at sorting of many cultivars cannot be seen in isolation from the many links in the chain that represent their exposure to physical laws that promote deterioration. Ultimately, the genetics and biochemistry behind many of the recognised flaws have had their origin in thermodynamic, psychrometric and mechanical influences.

在许多栽培种分选过程中，在果仁中发现的常见缺陷不能孤立于代表其受到促进变质的物理法则影响的众多链环节。最终 - 许多公认缺陷背后的遗传学和生物化学起源于热力学、湿度和机械影响。

A thorough understanding and application of the natural laws will provide the lowest common denominators to limit or isolate the physical causes of kernel deterioration, either in the growing phase or during post-harvest defects such as some forms of brown centring, discolouration, colour fixing, brown centring (bc), after roast darkening (ARD), glassiness, disfigured kernels, mass loss and rancidity.
对自然规律的透彻理解和应用将提供最低的共同标准，以限制或隔离籽粒退化的物理原因，无论是在生长阶段还是在采摘后的缺陷期间，如烘烤变暗（ARD）、玻璃化、变形籽粒、质量损失和酸败后的某些形式的棕色定心、变色、固色、棕色定心（bc）。

Definition: **THE LOWEST COMMON DENOMINATOR**
定义：**最低共同标准**

TREAT ALL THE MACADAMIA NUTS IN THE SYSTEM AS YOU WOULD THE NUT THAT NEEDS THE MOST ATTENTION!
像对待最需要关注的坚果一样对待系统中所有的澳洲坚果！

The application of the lowest common denominators refers to all post-harvest activities and processes and are highlighted as the following do's and don'ts in three parts;-
最低共同标准的应用是指所有采摘后的活动和过程，通过以下三个部分的"规矩"与"禁忌"来进行强调；-

1. **From orchard to the on-farm curing system.**
   从果园到农场烘焙系统。

2. **From the on-farm curing system to the processor.**
   从农场烘焙系统到处理器。

3. **The ideal curing and storage system.**
   理想的烘焙和储存系统。

1. **From the orchard to the on-farm curing system.**
   从果园到农场烘焙系统。

   (i) The **Don'ts** can be summarised as;
   禁忌可以概括为：

   - Do not believe that macadamias are indestructibly safe in their shells.
     不要相信澳洲坚果在它们的壳里是绝对安全的。
   - Do not leave nuts on the orchard floor for longer than one week.
     请勿将坚果遗留在采摘地面上超过一周

- Do not let fallen/harvested nuts be exposed to sunlight.
  请勿让掉落/采摘的坚果暴露在阳光下。
- Do not leave nuts on a wet orchard floor.
  请勿将坚果遗留在潮湿的果园地面上。
- Do not harvest nuts into closed plastic bags.
  请勿将采摘的坚果装入密封塑料袋中。
- Do not harvest nuts into contaminated containers.
  请勿将采摘的坚果装入受到污染的容器中。
- Do not expose nuts to rapid or severe temperature increases.
  请勿将坚果暴露于迅速/剧烈升高的温度中。
- Do not handle nuts roughly or drop them.
  请勿粗暴处理或投掷坚果

(ii) The **Do's** can be summarised as;
规定可以概括为：

- Do maturity tests to establish the harvest window.
  进行成熟度测试以建立采摘窗口。
- Do keep the harvest floor clean.
  确保采摘地面清洁
- Do de-husk today's harvest today.
  确保当天采摘当天去壳
- Do sort damaged NIS out thoroughly before consigning to the curer.
  请把损坏的 NIS 彻底分类，然后交给焙固机。
- Do keep records of every orchards' production and losses.
  请务必记录每个果园的产量和损失。

2. From the on-farm curing system to the processor.
从农场烘焙系统到处理器。

See figure 1 - Safe storage parameters under sustained conditions and figure 2 - The equilibrium moisture content values at which nut-in-shell (NIS) may be cured to establish an acceptable shelf life for quality macadamias. The curing rate that has been established empirically as 2% moisture loss per day – Figure 3.
见图 1 -持续条件下的安全储存参数和图 2 -硬壳坚果（NIS）可烘焙的平衡水分含量值，以确立优质澳洲坚果可接受的保存期。根据经验确定的烘焙速率为每天 2%的水分损失 - 图 3。

(i) The Don'ts for on-farm curing, storage and delivery to the processor are summarised as follows;
农场烘焙、储存和交付给处理器的禁忌总结如下：

- Do not delay the curing process - begin immediately after de-husking
  请勿延迟烘焙过程 - 脱壳后立即开始
- Do not subject NIS to a temperature exceeding 30ºC (especially if mc > 15%)
  请勿将 NIS 置于超过 30℃的温度下（尤其是当 mc> 15％时）

- Do not subject the NIS to stop/start drying
  请勿让 NIS 停止/开始干燥
- Do not re-wet the NIS with process air wetter than its EMC value
  请勿用比其 EMC 值更湿的工艺空气重新润湿 NIS
- Do not subject the NIS to excessively dry air or rapid drying exceeding 2% per day.
  请勿让 NIS 每天经受过度干燥的空气或超过 2%的快速干燥。
- Do not over dry. (<7% NIS mc)
  请勿过度干燥。（<7% NIS mc）
- Do not allow the NIS to be dropped or otherwise subjected to impact damage
  请勿让 NIS 坠落或受到其他冲击损坏
- Do not allow cured NIS to be stored or transported under a hot roof or tarpaulin.
  请勿在热顶盖或防水油布下存储或运输经烘焙的 NIS。

(ii) The Do's for on-farm curing, storage and delivery may be summarised as follows;
农场烘焙、储存和交付的规矩总结如下：

- Do remember that macadamias should be cured, not dried.
  请记住澳洲坚果应该被烘焙，而不是干燥。
- Do keep to the safe storage parameters indicated in Figure 1.
  请务必保持图 1 所示的安全存储参数。
- Do deliver NIS to the processor with a mc >7% and <12% (optimum 8-10%)
  请务必以大于 7%且小于 12%（最佳为 8-10%）的 mc 向处理器交付 NIS
- Do endeavour to complete harvest to delivery to the processor in one month.
  请务必在一个月内完成采摘并交付给处理器。
- Do keep a record of every batch and the conditions during curing.
  请务必记录每个批次和烘焙过程中的条件。

3. The Ideal Curing and Storage System
理想的烘焙和储存系统

(i) The correctly designed dryer should have an explicit design and fabrication enabling it to cure;
正确设计的干燥器应该有明确的设计和制造，使其能够在以下条件下进行烘焙：

- In all weather conditions.
  在任何天气条件下。
- The wettest potential of a specified mass of NIS
  指定质量的 NIS 的最湿电位
- In accordance with the safe parameters established for macadamias
  根据澳洲坚果的安全参数
- Accurately and uniformly to a prescribed EMC – Fig 1.
  精确且一致地达到规定的 EMC – 图 1。

- Within the prescribed time (5-7 days: 20+% →10%mc) – Fig 2.
  在规定时间内（5-7 天：20+%→10% mc）– 图 2。
- At a low energy cost.
  能源成本低。

(ii) A drying system must not compete against;
干燥系统不得与之竞争；

- Free water entering the system
  自由水进入系统
- Internal condensation e.g. from a failed air flow and/or temperature loss
  内部冷凝，例如由于故障气流和/或温度损失
- Manufactured excess humidity from a nearby wet process (water sorting?)
  由附近的湿法工艺（水分选？）产生的多余湿度
- Exposure to extremes in temperature
  暴露在极端温度下
- Exposure to wind
  暴露在风中

In Conclusion ….. The Pareto Principle!
最后…….帕累托法则！

It takes 20% effort to achieve 80% success. To achieve excellence the additional 20% reward takes a further 80% effort.
取得 80%的成功需要 20%的努力。为了获得卓越的表现，额外的 20%奖励需要付出 80%的努力。

So, to preserve the shelf-life of the harvested quality of macadamias the principles of the lowest common denominator must be applied to …….
因此，为了保持澳洲坚果的储存期限，必须将最低共同标准的原则应用于……

…treat the weak nuts, the hurt nuts, the nuts with the risk of losing early shelf life - wherever they are in the system - with care so that they do not become a bad experience for your customer …
…处理脆弱的坚果、受伤的坚果、具有可能会提早损失保存期限风险的坚果-无论它们在系统中的任何位置-都要小心对待，以免对客户造成不良体验 …

and a bad advert for you!!
反而带给你负面效应！