

Formulation
Science & Technology



A subject group of the RSC



**Can you be certain the
Skin Anti-ageing product
you formulated
is the one the consumer is using?**

**Dr Barbara Brockway
Director Personal Care
Applied DNA Sciences**

Sept 18th 2018

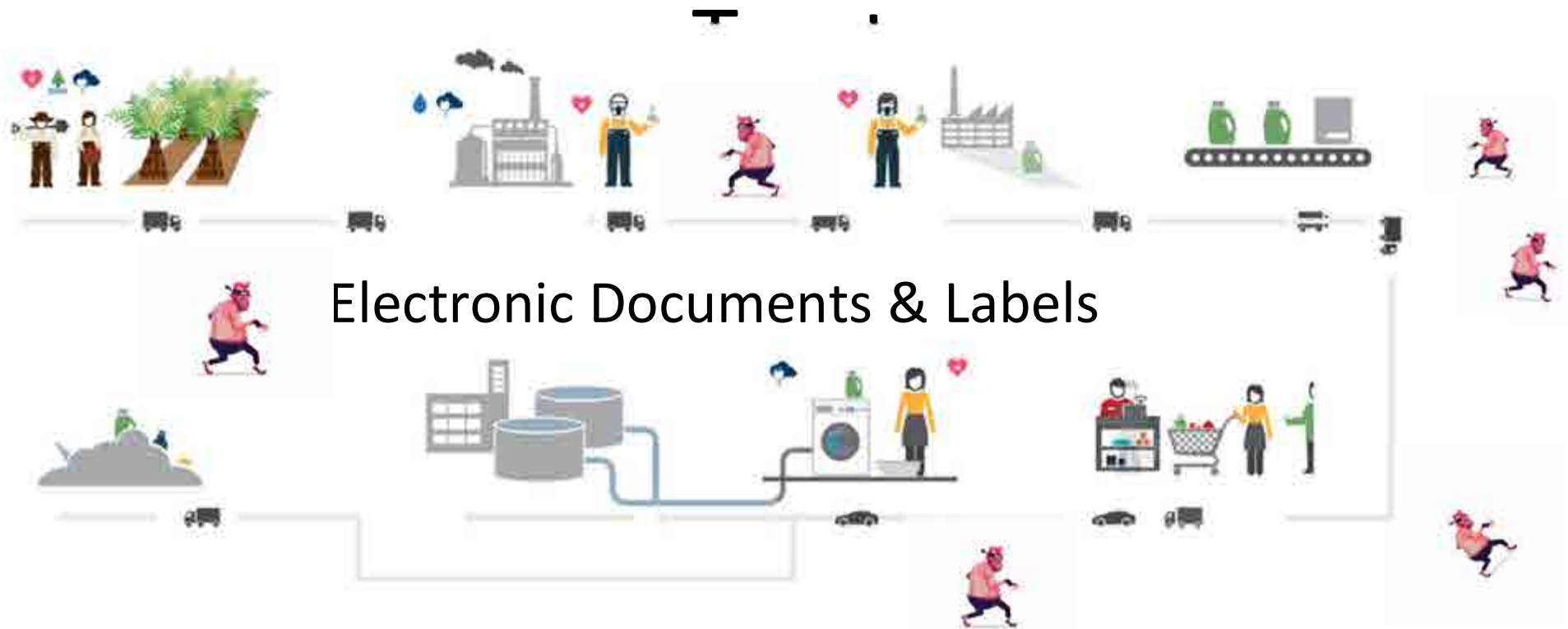
Making counterfeit products has become a form of entertainment in China.

- On the trending section of Chinese short video platform Douyin you can find [videos of DIY cosmetics](#)
- A vlogger pours a prepared liquid into a lipstick stub, shapes it with a heating tool, and then sticks on brand logos.
- In under two minutes, she makes lipsticks, lip gloss, and cushioned foundations packaged as brand new products from Dior, YSL, Givenchy, Chanel, MAC, and more.
- The Chinese counterfeit industry reportedly costs foreign firms up to \$20 billion a year in lost profits.

Brands are taking action to prevent counterfeiting, with, for example, high-end cosmetic brands like Estée Lauder, SK-II, La Mer, and Sulwhasoo offering to recycle their customers' empty skincare bottles.
<https://jingdaily.com/video-counterfeit-china/>



Supply Chains Rely on Audited



Supply Chains Rely on Audited



The Power of Forensic Science & DNA

CSI-TV
Bringing forensics into
everyday lives
www.all-about-forensic-science.com

CRIME SCENE DO NOT CROSS

"Wherever he steps, whatever he touches, whatever he leaves, even unconsciously, will serve as silent evidence against him. Not only his fingerprints or his footprints, but his hair, the fibers from his clothes, the glass he breaks, the foot mark he leaves, the paint he scratches, the blood or semen that he deposits or collects. All these and more bear mute witness against him. This is

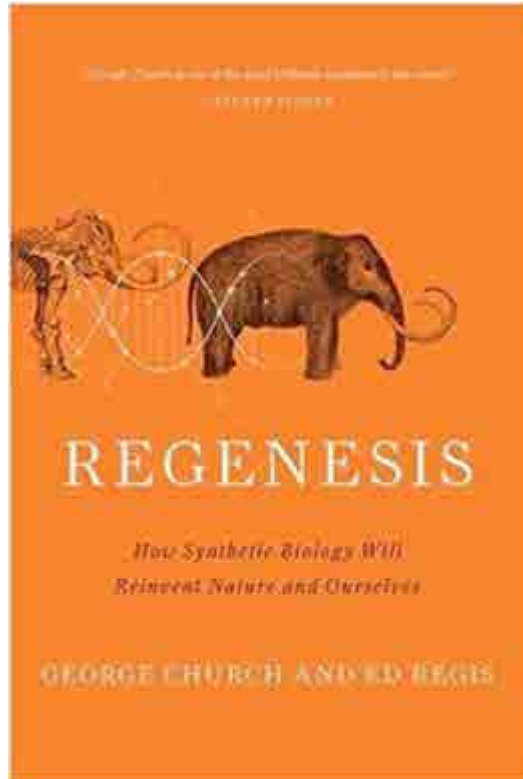
It is so important now to be
Certain &
Transparent

REGENESIS
*How Synthetic Biology Will
Reinvent Nature and Ourselves*
GEORGE CHURCH AND ED REGIS

- Biofuels
- Bioplastics
- Engineered enzymes
- Engineered cells, multi-enzyme systems
- DNA vaccines
- Cancer immunotherapies, CAR-T
- Personalized medicine, CRISPR
- Data storage
- Track & Trace

Provides proven transparency

Consumers appreciate that science is proof *not just belief*.



Most published book – that you have never heard of...

70 billion copies of it in existence, Church and Kosuri took the book's computer file (binary code) & with the aid of a computer program, they translated the binary code into DNA's quaternary code, this translation was achieved in just a couple of weeks They stored the DNA on a chip and then sequenced it to read the text. The book is broken up into little chunks of DNA, each of which has a portion of the book itself as well as an address to indicate where it should go. They recovered the book with only 10 wrong bits out of 5.27 million. Using standard DNA-copying methods, they duplicated the DNA into 70 billion copies.

DNA's / Reliable copies

DNA is a Cosmetic Material

DNA is a recognized cosmetic



INCI Name / Substantive Name	CAS No.	EC No.	Restrictions / Annex / Ref. #
1. NANNINONE PROPIONIC ACID	7041-76-6	012-912-9	
2. NANNINONE PROPIONIC ACID			
3. NANNINONE PROPIONIC ACID			
4. NANNINONE PROPIONIC ACID			
5. NANNINONE PROPIONIC ACID			
6. NANNINONE PROPIONIC ACID			
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Quick searching DNA in COSING data base.....

Version: EC Regulation
Name or CAS/EC #: DNA
Scope: All
Status: Active
Search



DNA is Safe

DNA is ubiquitous & GRAS

Every living cell contains DNA

- DNA is intrinsically safe
 - You eat around 1g DNA in food daily
 - DNA is in drinking water
- When we lose skin cells, we are also shedding its DNA
- Shake hands and you exchange the DNA in the skin microbiome
- Personal care products, especially those with natural extracts, contain DNA



50 mL EL cream	DNA content	Unit
Double strand DNA	95.8	ng
Single strand DNA	5632.5	ng
Total	5728.3	ng
	5.73	µg

Estée Lauder's Advanced night repair
synchronized recovery complex II
Contains around 6µg/g DNA

Source: Analysis Conducted
August 2016, Applied DNA
Sciences Laboratory Stony Brook
New York

FDA know DNA is Safe

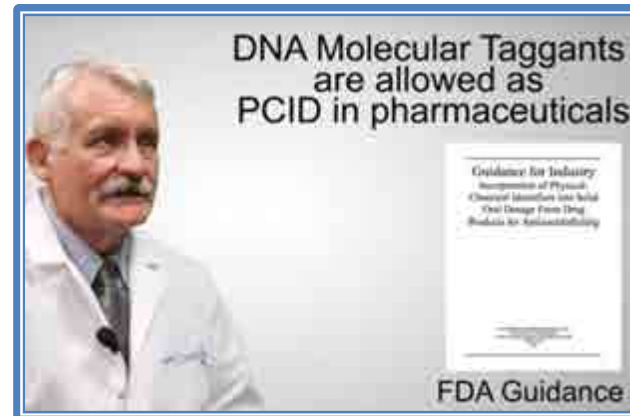
DNA is allowed in pharma as Physical Identifier (PCID)

—Up to 150 μ g per dose

- which is a billion times more DNA than SigNature[®] DNA molecular tags are used in formulas

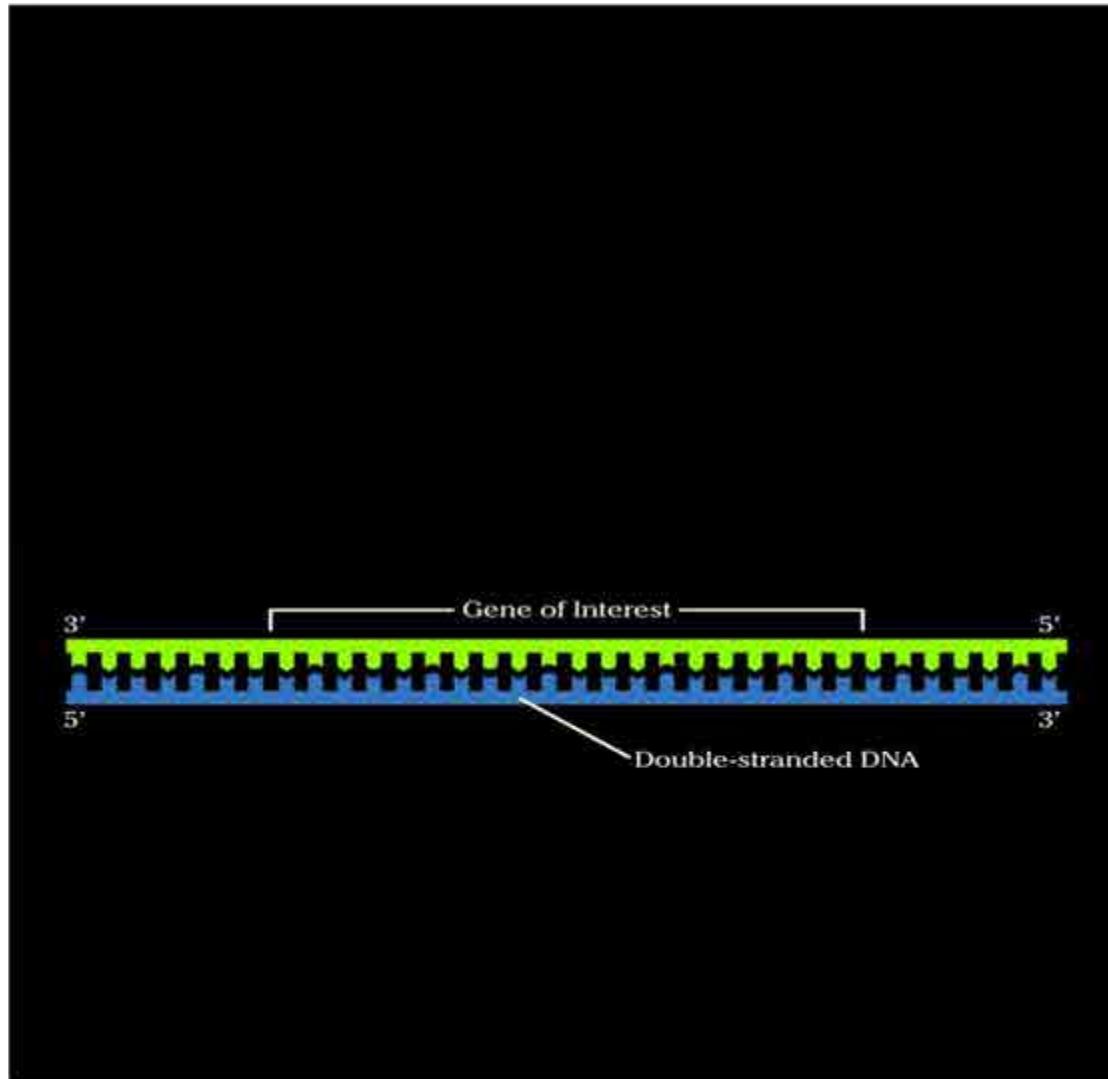
"FDA have put a lot of work into how much DNA and the kinds of DNA that can be employed in Pharma"

Michael Hogan,
Vice President, Life Sciences,
Applied DNA Sciences



<http://bit.ly/2aV6DNW>

PCR *Selective Signal Amplification*



Polymerase chain reaction (PCR)

Unique Bulk DNA Production

Patented (US, Can, China, Israel, EUR-pending) continuous flow system, scaling PCR from micro-liters to liters

- Vaccines, diagnostics, reagents, bio-agriculture, and gene therapies for existing and emerging markets.
- Clinical trial to commercial supply

Benefits of PCR at the Industrial Scale

- Product Flexibility. Short to long amplicons
- No cellular contamination
- Nucleic Acid Chemical Modification
- Scalable Production
- Reduced Lead Time
- Cost-effective



**Enabling PCR-based DNA
Chemistry at an Industrial Scale**

CSI-Type/DNA Technology

Applied DNA Sciences

- U.S. Department of Defense agency contracts:
 - Defense Logistics Agency, Missile Defense Agency, Office of Secretary of Defense
- Two un-named U.S. federal agency contracts
- U.S. Department of Agriculture multi-year collaboration agreement on DNA genotyping
- Over 200 million pounds of DNA tagged and DNA-genotyped cotton; 1,250 SKUs in 1000 stores
- Over 60,000 cars marked; over 70,000 marking kits shipped
- Over 850,000 microcircuits DNA-marked and in circulation
- World's largest PCR-based mass producer of DNA
- 117 Convictions achieved in UK re cash crimes
- Deep experience in Personal Care





Focusing on the mission.
Delivering the best outcome.
DNA makes it possible.

Helping the Defense Logistics Agency secure its electronic microcircuit supply chain.

Over 700 thousand components marked.

Cash and valuables
safely transported.
DNA makes it possible.

The use of DNA-marked
degradation dye in the UK has
resulted in a 75% reduction in
cash transport attacks.

115 Convictions
>500 Sentence Years





Enjoying a drive
with the family.
DNA makes it possible.

Detering automobile theft in
Sweden using SmartDNA asset
tagging in conjunction with
electronic anti-theft systems.

Recovered Steering
Wheel from Chop Shop
Sting in Stockholm

Location of DNA
highlighted by fluorophore

Arrests of e commerce gang in Asia
ongoing



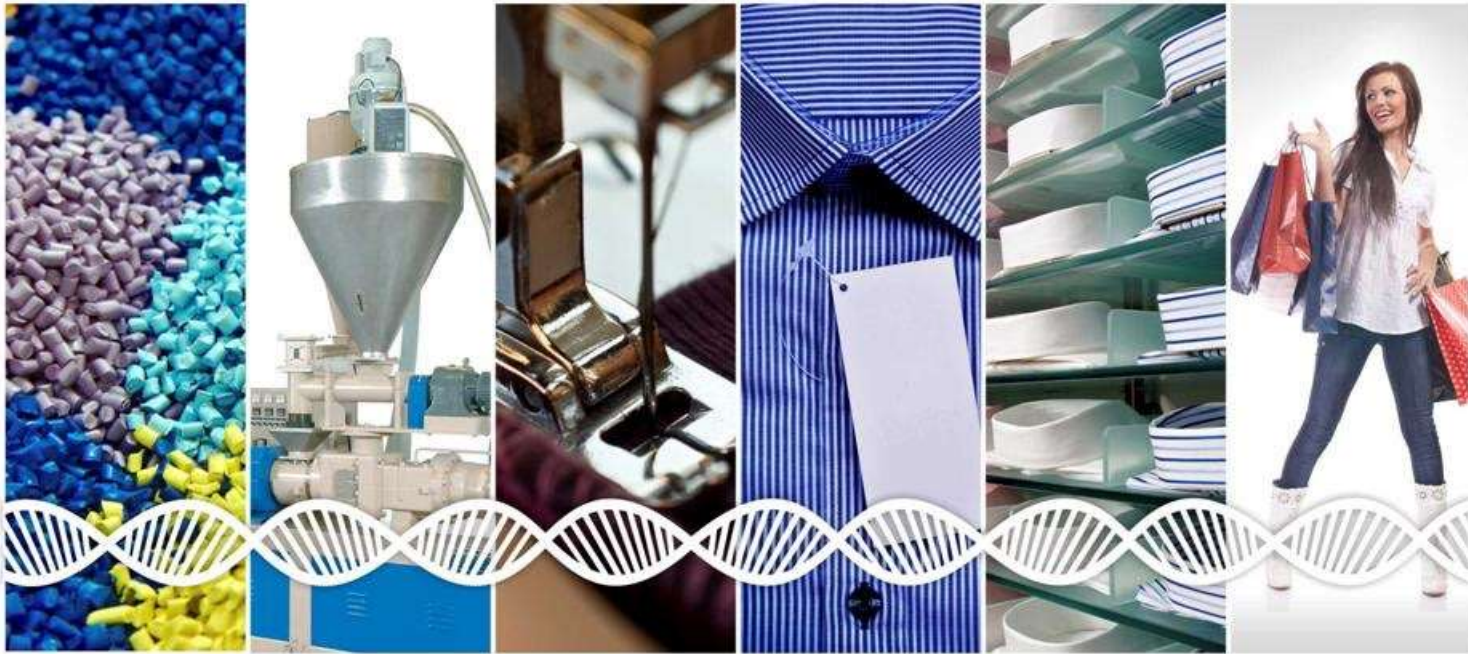
Press Conference by Lithuanian
Police after DNA trail broke supply
chain packaging gang



Pouring your heart and soul
out on stage without worrying
about your gear.
DNA makes it possible.

Definitive authentication of premium-quality
musical instruments using DNA markers.

CertainT™ for recycled PET



Copyright Applied DNA Sciences Inc.



Why protect leather?

Verify claims:

Sustainably produced

No deforestation

Controlled effluent discharge

Responsible use of chemicals Animal welfare

Ethically sourced

No slave labour

Traceability:

Protect upstream sustainability credits beyond the split leather trading process



That new prescription
is having a positive
impact on your life.
DNA makes it possible.

Preserving patient safety and benefit
by ensuring drug authenticity and
active ingredient integrity.

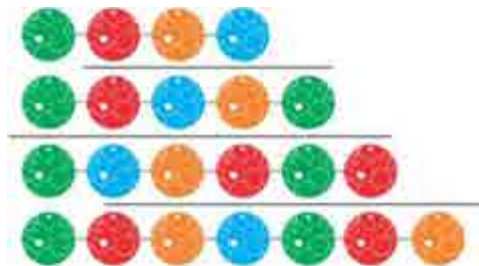
Creating a DNA Tag

Define Desired Purpose / Functionality

Provenance
Traceability
Origin
Sustainability
Authentication
Ethical Sourcing



Create Appropriate Molecular Tag



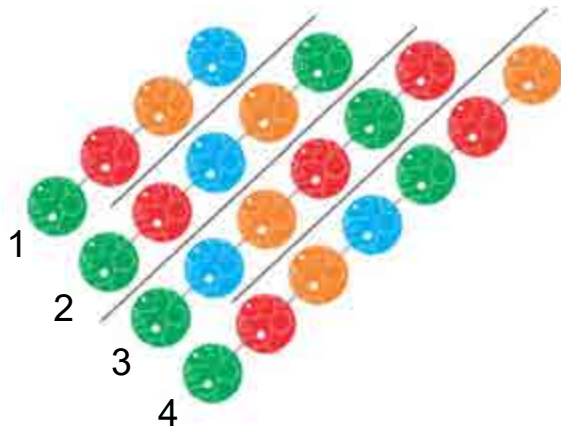
Parts per trillion

- Short, inactive, inert molecule level “A-C-T-G-C-T-A-G” Tag
- Less than 200 base pair; no gene function
- Most secure “Bar Code” in the world
- *Traceable at parts per billion/trillion*
- Trusted by Governments
- Forensic evidence admissible in a court of law



DNA as 'Green Barcodes'

conveying the information as you need



1. Validates ingredient
2. Validates ingredient from a specific location
3. Validates ingredient from a specific supplier
4. Validates the ingredient was certified as Vegan, Organic, Fair Trade, etc...

Molecular SigNature "Bar Code" information can be used to:

- Prove provenance
- Distinguish Certified & Sustainable materials
- Date stamp stages of processing
- Carry any information required
- **Show a product was used correctly in clinical trials**
- Quickly prove a material is present in complex formulas

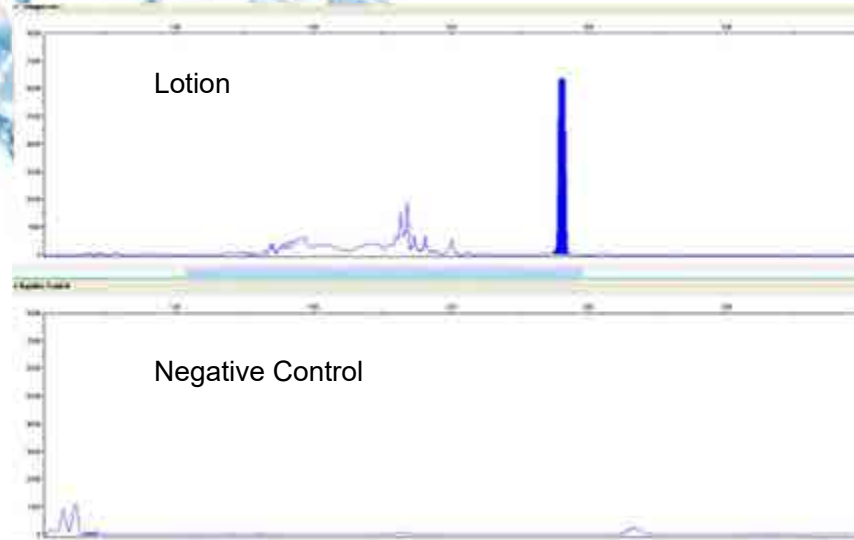
Double Blind Testing

Did the participants in the trial follow the protocol and apply the test cream ONLY to their right cheek?



Show a product was used correctly in clinical trials

Lotion



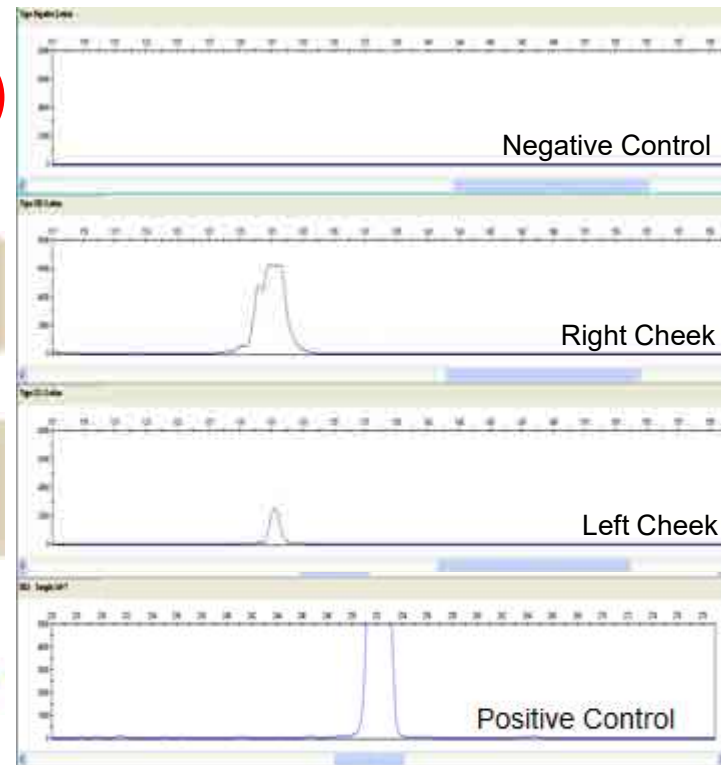
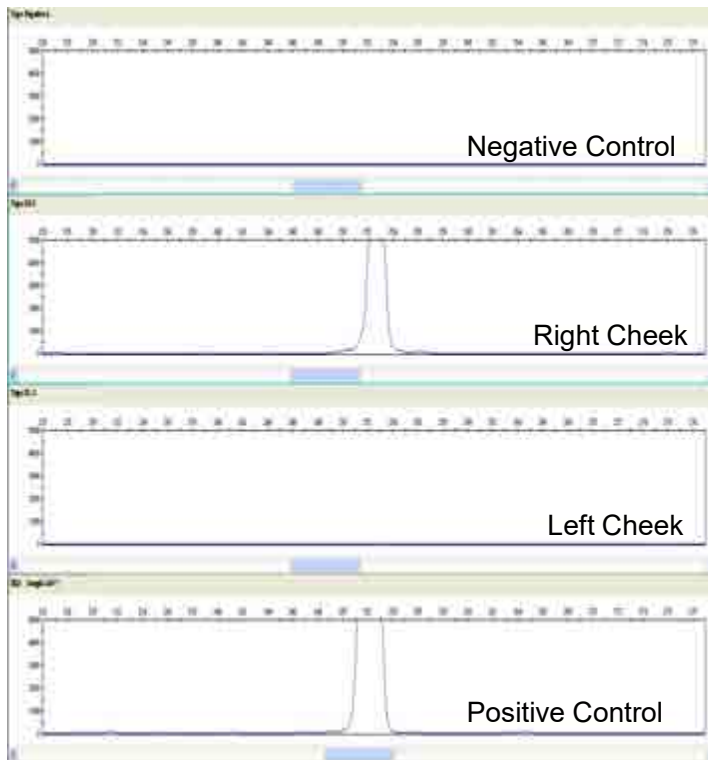
SigNature DNA botanical mark is detectable in the trial lotion.

SigNature® DNA marker was positively authenticated from Lotion Sample.

DNA Detection on Tape Strip Samples

Trial Participant A applied during daytime

Trial Participant B applied before retiring at night

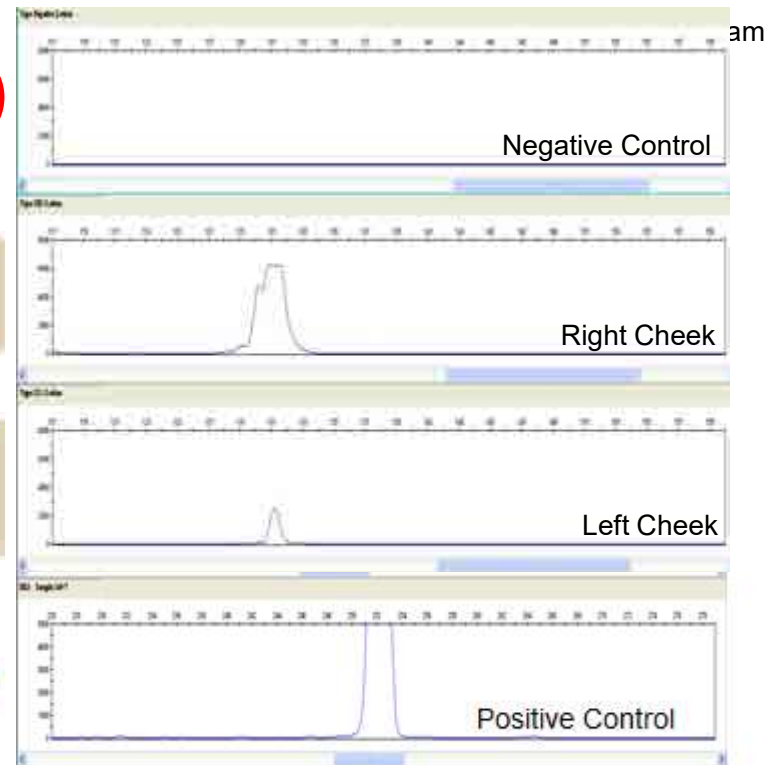


Double Blind Testing

Did the participants in the trial follow the protocol and apply the test cream ONLY to their right cheek?



Yesbut because Trial Participant B slept, a significant amount of the test cream was transferred via the pillow, to their left cheek so their data should not be used in the double-blind study.



Knowing the protocol was followed is crucial



- Despite the best intentions, mistakes happen and could go unseen
- Eliminating false data increases confidence in results
- Where effects are small, eliminating false data can be the only way to prove efficacy

Supply Chains



Food Scandals Show System Failures

Food Standards Agency investigates allegations that meat traces 'found in Tesco and Sainsbury's vegetarian and vegan food'

'Our priority is to ensure consumers can be confident that the food they eat is safe and is what it says it is'

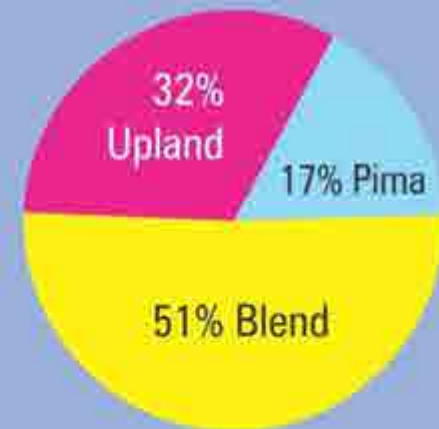
Oliver Wheaton | Saturday 9 June 2018 09:41 |  10 comments

Even in the most highly controlled supply chains there are scandals!

83 percent

of the products tested **did not** contain 100% Pima, as was promised on the label.

In other words, only 17% of the samples actually contained 100% Pima Cotton.



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Indian Company Admits 'Error' After Target Cuts Ties Over Egyptian-Cotton Dispute

8:10am Aug25th

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Wal-Mart Probes Whether India Company Misrepresented Cotton Sheets

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1:37pm Aug30th

RISK & COMPLIANCE JOURNAL | COMMENTARY

Crisis of the Week: Welspun India Faces 'Sheet Storm' Over Egyptian Cotton Claims

By **BEN DIPIETRO**

Aug 30, 2018 1:37 pm ET

This is a weekly commentary by external experts. Textile supply company Welspun India Ltd. is under the crisis microscope after Target Corp. cut ties with the company after

Welspun India admitted the Egyptian cotton claims. Welspun's stock price

dropped sharply on the news.

Indian Company Admits 'Error' After Target Cuts Ties Over



Bloomberg
Markets

Markets

Tech

Pursuits

Politics

Opinion

Businessweek

Welspun Declines After Wal-Mart Joins Target to Pull Bedsheets

by **K Oanh Ha**

12 September 2016 05:11

→ Welspun stock slumped by about half over past three weeks

Welspun India Ltd. shares slid as much as 5 percent in Mumbai trading after Wal-Mart Stores Inc. stopped selling the supplier's Egyptian-cotton sheets over concerns that the

DNA Testing Could Put an End to Fake Egyptian Cotton

Scientists want to make sure your luxe sheets are actually worth the price tag.



A cotton shrub during the cotton harvest in Benha, Egypt. Photographer: Shawn Baldwin/Bloomberg

In a small laboratory housed in a biotech incubator 90 minutes east of New York City are six bins tightly packed with sealed plastic bags of men's dress shirts, sheets, and tufts of cotton ready to be spun into yarn. The materials are waiting to be DNA-tested with the same rigor you'd find in an FBI crime lab. But rather than seeking clues in a murder, the forensic scientists at biotech company Applied DNA Sciences are looking for a unique DNA stamp in the fibers to see whether the textiles are, in fact, made of the premium cotton their labels claim.

DNA Testing Could Put an End to Fake Egyptian Cotton

Scientists want to make sure your luxe sheets are actually worth the price tag.



A cotton shrub during the cotton harvest in Benha, Egypt. Photographer: Shawn Baldwin/Bloomberg

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End Uzbek Cotton Crimes

Every autumn over a million of Uzbek citizens are forced by their own government to leave their regular jobs and go to the fields to pick cotton.

A big part of this cotton ends up in global supply chains and in our high street shops.

Fully-Automated DNA Transfer System and Process Control “Industrial Internet of Things”



Gin location



Presence of cotton
(flowing/not flowing)



Amount of SigNature T being
sprayed



Status of system



Status of gin connections



Date/time



Bale production rate



Amount of SigNature T concentrate
remaining



CSI-Type/DNA Technology in Cotton Supply Chain Transparency



Product Provenance

- ▶ Cotton: Harvested in California, USA 2/2015
- ▶ Yarn: Made in China – 3/2015
- ▶ Fabric: Assembled in India – 4/2015
- ▶ Distribution: Arrives in Maryland, USA – 5/2015
- ▶ Retail Store: Arrives in New York, NY – 5/2015

Product Description

- ▶ 6-Piece Cotton Bed Set – 33454
- ▶ Queen Size
- ▶ Red/Orange Floral
- ▶ \$39.99

PimaCott





“This luxurious pure pima cotton sheet set ranked highest for softness, performance, and durability.”



Good Housekeeping Best Buy 2017

BED BATH & BEYOND®

- 10% increase in home textile sales 2017
- 15-20% increase projected for 2018
- Improved margin, increased efficiency



PimaCott

USA Aloe vera Products BCOL D

No Evidence of Found in the A Mart, CVS

Wal-Mart, Target, CVS sell aloe

by **Lydia Mulvany** and **Zeke Faux**
November 22, 2016 — 5:00 AM EST Updated on: Nov

The aloe vera gel many Americans buy to s
aloe vera at all.

Samples of store-brand aloe gel purchased
CVS showed no indication of the plant in v
barbadensis leaf juice — another name for
No. 2 after water.

Inbox (19)



Thank you for reaching out to us and for being a loyal customer. We understand your reaction to the report you linked to, but we stand behind our products, which we know to contain aloe vera, contrary to the faulty and inaccurate Bloomberg report. What the article didn't mention is that we invited the Bloomberg reporters to the aloe processing facilities so that they could see the aloe leaves being brought into the facility (which is Ecoert and Fair for Life certified) and verify that the raw material in our products is in fact aloe. The only true "test" to determine the presence of aloe is to trace or witness the raw material from the leaves to the end product, which we can certainly do and had offered to Bloomberg weeks before it ran this misleading report.

Again, we thank you for reaching out to us and will continue to defend our products against inaccurate and misleading reports such as this.

Thank you,

Rena McLaughlin
Fruit of the Earth
Customer Technical Services
3101 High River Road, Suite 175
Ft. Worth, TX 76155

DNA Molecular
tags can be that
silent witness

Is real transparency possible? L'Oréal exclusive interview

By Lucy Whitehouse [↗](#)

14-Jun-2018 - Last updated on 14-Jun-2018 at 14:05 GMT

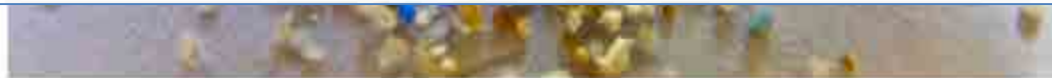


Is real transparency across the supply chain realistic, and how can we work towards this?

Transparency across the supply chain is not only realistic, it is necessary if we want the consumers' confidence to increase.

When we buy meat or fruits, we want to know where they come from. Our consumers have the right to get this information on our products.

That's what our program Sharing Beauty With All (SBWA) also includes.



Veronique Poulsen, Head of Environmental Safety, L'Oréal, gives us her take on the rising demand across the industry for sustainability.

Garnier SkinActive product line certified Cradle to Cradle

By Deanna Utroske

14 Jun 2018 - Last updated on 14 Jun 2018 at 16:33 GMT



Image courtesy of L'Oréal

This month, L'Oréal announced that five products in the SkinActive skin care portfolio have attained Cradle to Cradle sustainability certification.

At the Sustainable Brands conference in Vancouver, British Columbia, L'Oréal announced that the following skin care products all manufactured in Franklin, New Jersey, are Cradle to Cradle Silver certified:

- Garnier SkinActive Deep Pore Facial Cleanser with Green Tea
- Garnier SkinActive Refreshing Facial Cleanser with Aloe Juice

1.3.3 PREPARING SAMPLES TO BE SENT TO THE LAB

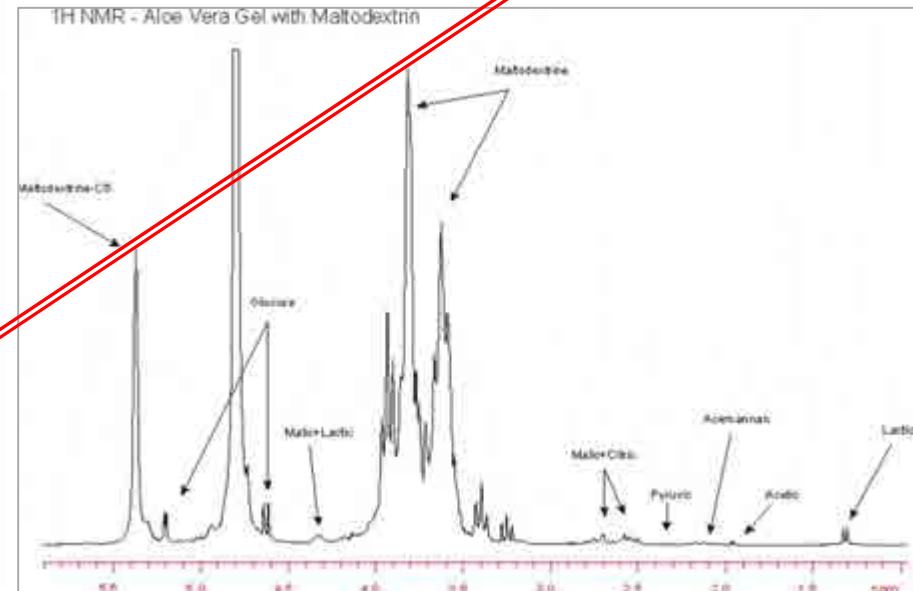
The coordinator will determine which samples are to be sent to the lab and prepare 2 samples of each product to be sent for testing. One lab will perform the NMR analysis, and the extra sample will be sent to another independent laboratory for aoin testing.

For aloe vera raw material

- The coordinator will send whatever was sent by the applicant - **no products will be sent that contain any added thickeners! These will not go through the NMR process**

For aloe Inner-leaf

- The coordinator will send whatever was sent by the applicant - send complete and intact



Barcode of Life

A Taxonomy Tool



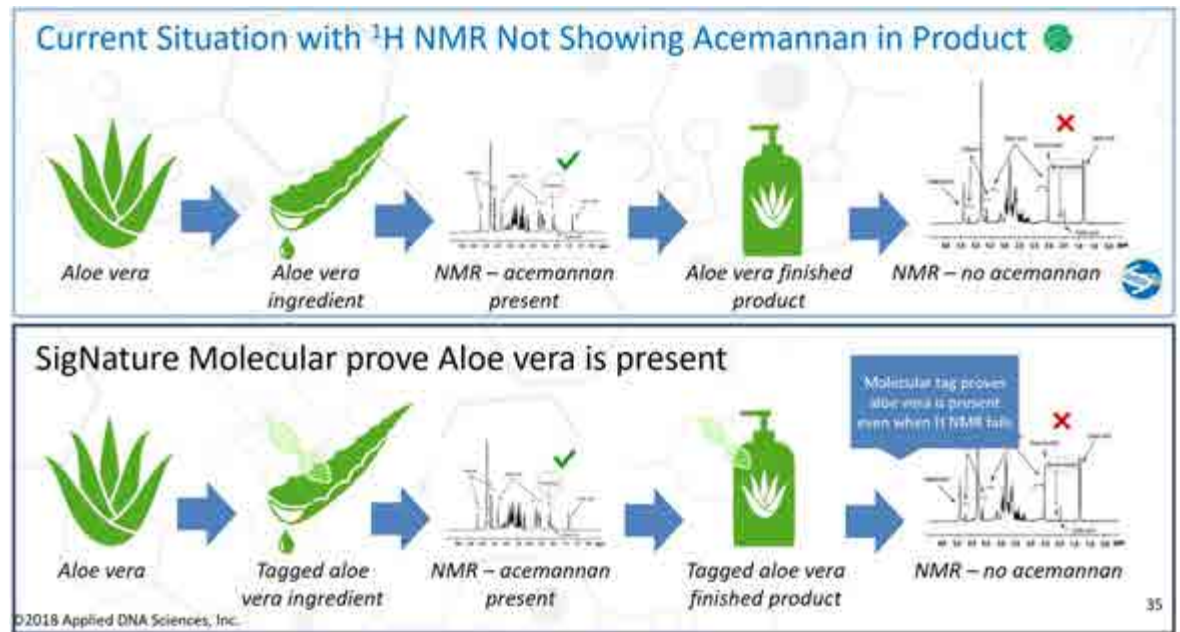
Genomic DNA Does not always survive processing



Resilient & Reliable DNA Molecular Tags

- Prove ingredients are in complex processed formulas *Even when analytical chemistry & BCOL fail*
- Quick & Strong supporting evidence to ward off expensive legal battles and brand damaging bad press

DNA Molecular tags can be that silent witness





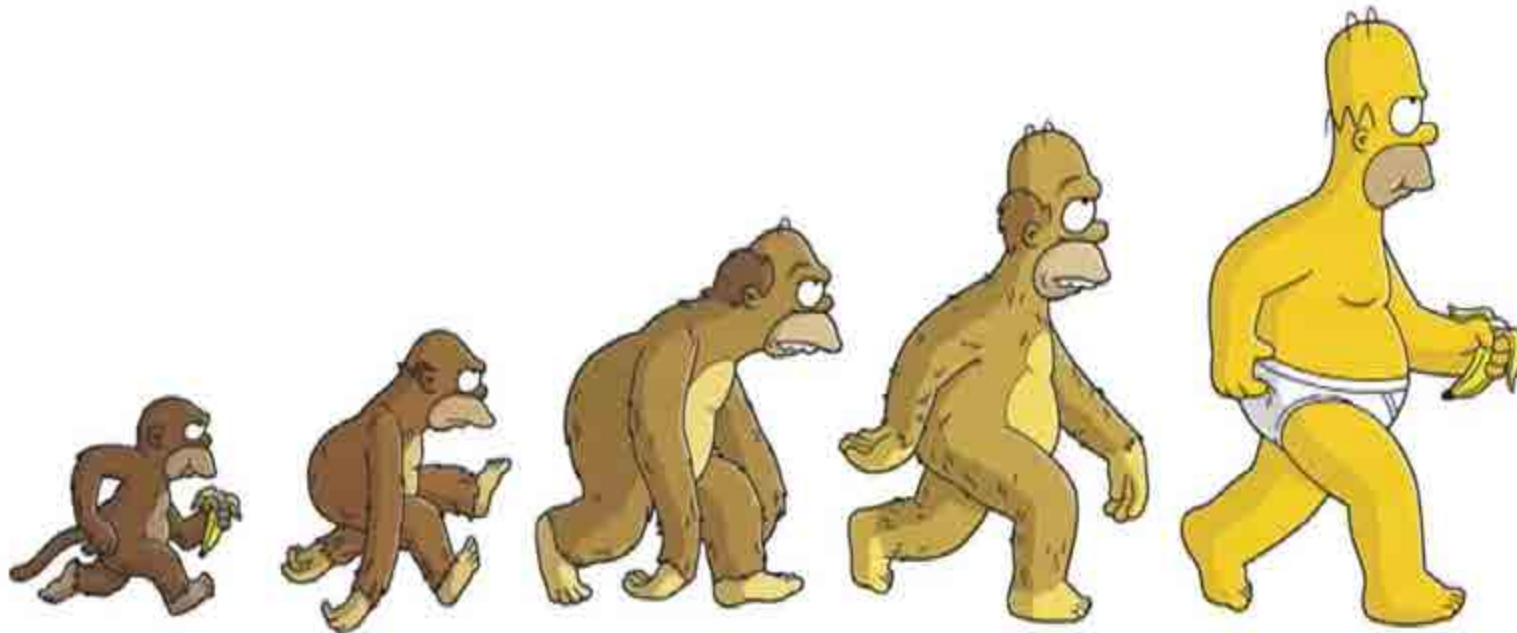
DNA

Linear Code in Molecular Polymer Similar
to Machine Code (but more dense)

Tags at the molecule level

“A-C-T-G-C-T-A-G”

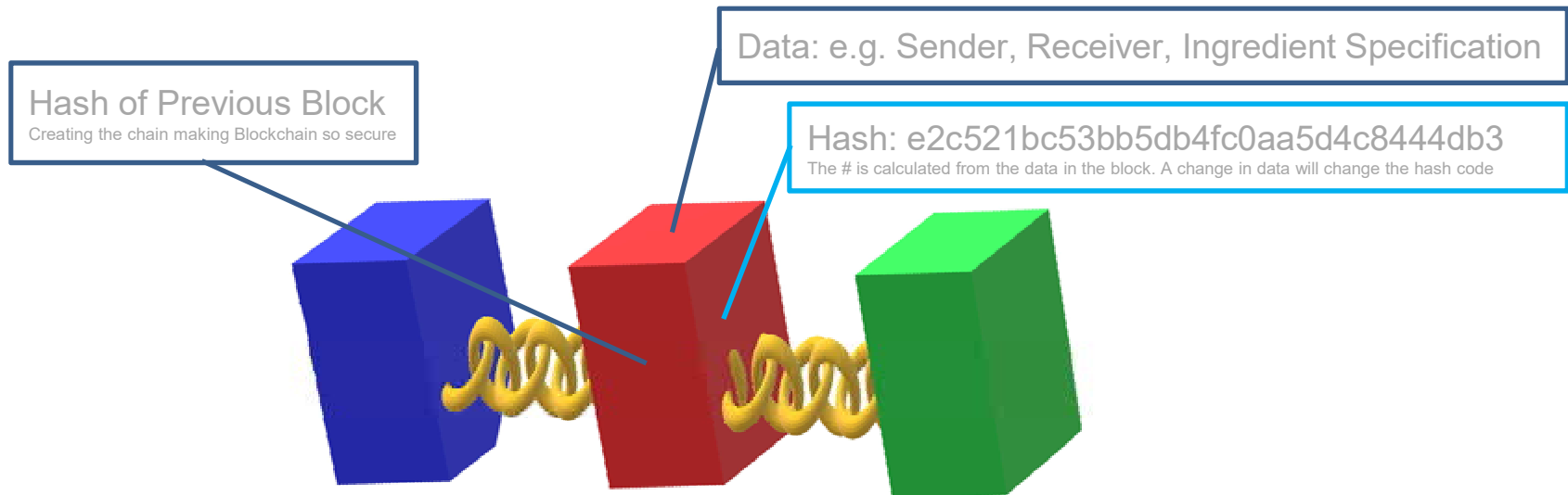
Blockchain: evolution of the internet



Internet of information to internet of value

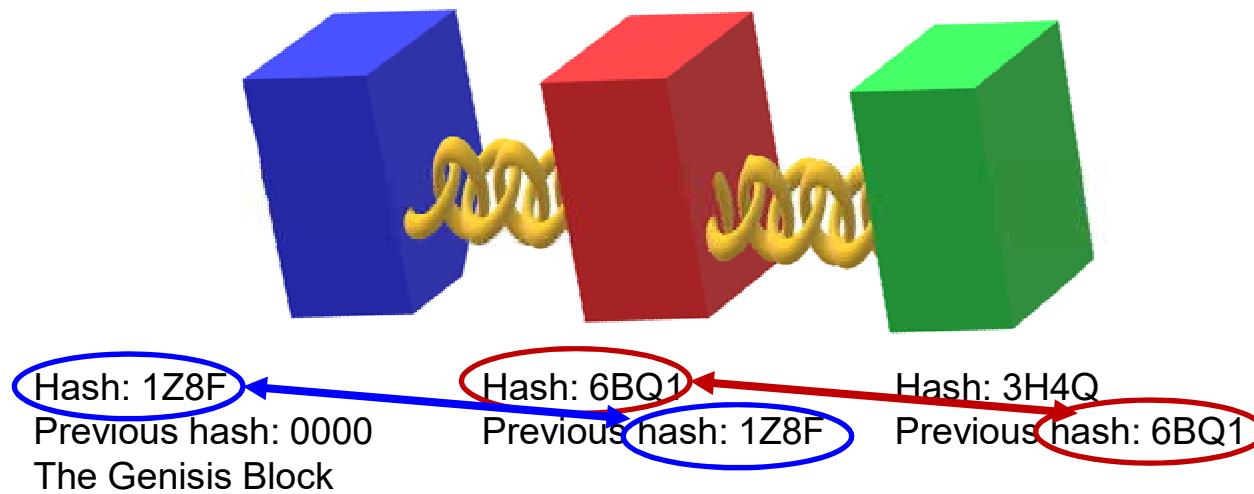
<http://www.tazrouti.com>

Blockchain



- 1st described in 1991 as tamper proof date stamp for electronic documents
- *Satoshi Nakamoto in 2009 used Blockchain for Crypto currency – Bitcoin*
- Linked Data Blocks / Distributed Ledgers that are open to everyone participating in the Blockchain

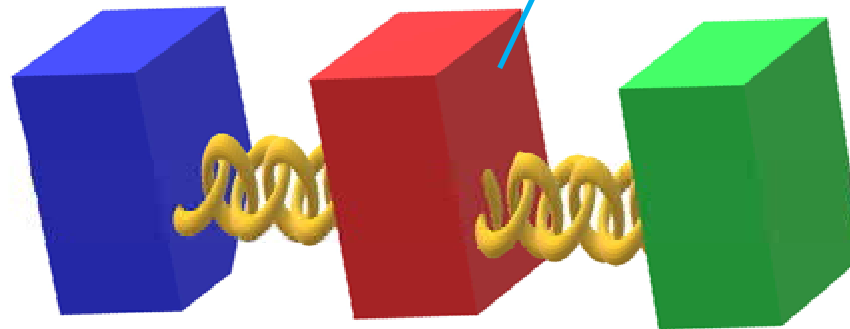
Blockchain



Blockchain

If someone changes the data in a block in the chain
Say they add or change an instruction

Hash: 6BQ1 changes to **H62Y**
The # is calculated from the data in the block. A change in data will change the hash code



Hash: 1Z8F
Previous hash: 0000
The Genesis Block

Hash: ~~6BQ1~~ H62Y
Previous hash: 1Z8F

Hash: 3H4Q
Previous hash: ~~6BQ1~~ !!!!

Changing a single block would make all following blocks invalid but because the corrupted blockchain is now 'different' to other copies of the blockchains it is automatically corrected.

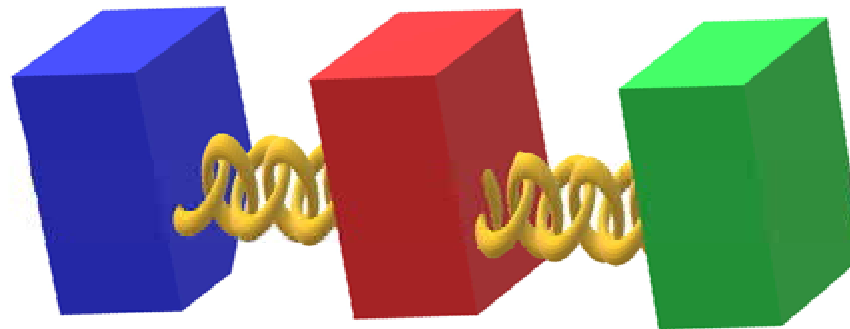
Blockchain

PROOF OF WORK

To prevent computers simply recalculating all the new hashes following a tampering incident

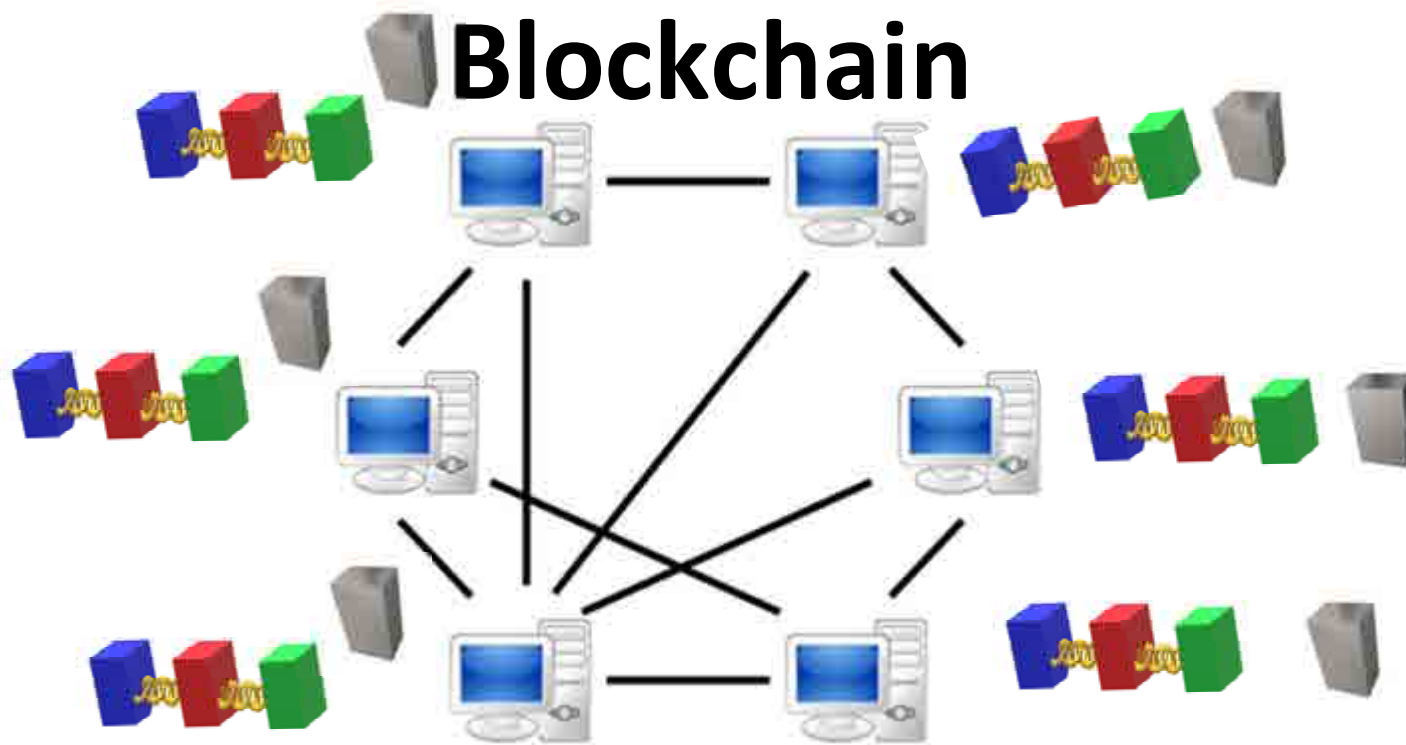


E.g. Bitcoin takes
10 min/block



PROOF OF WORK

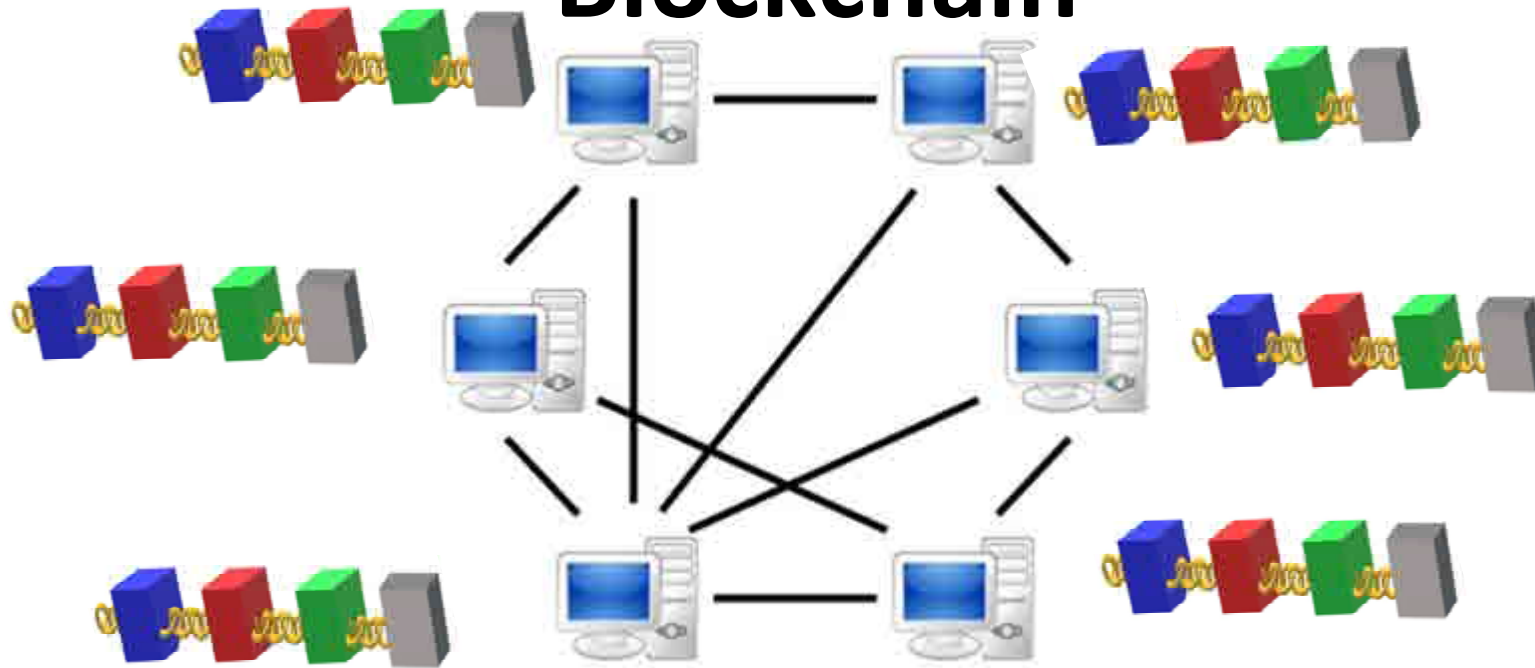
Its important that re-calculating new false hashes for each block would take to much time to be practical.



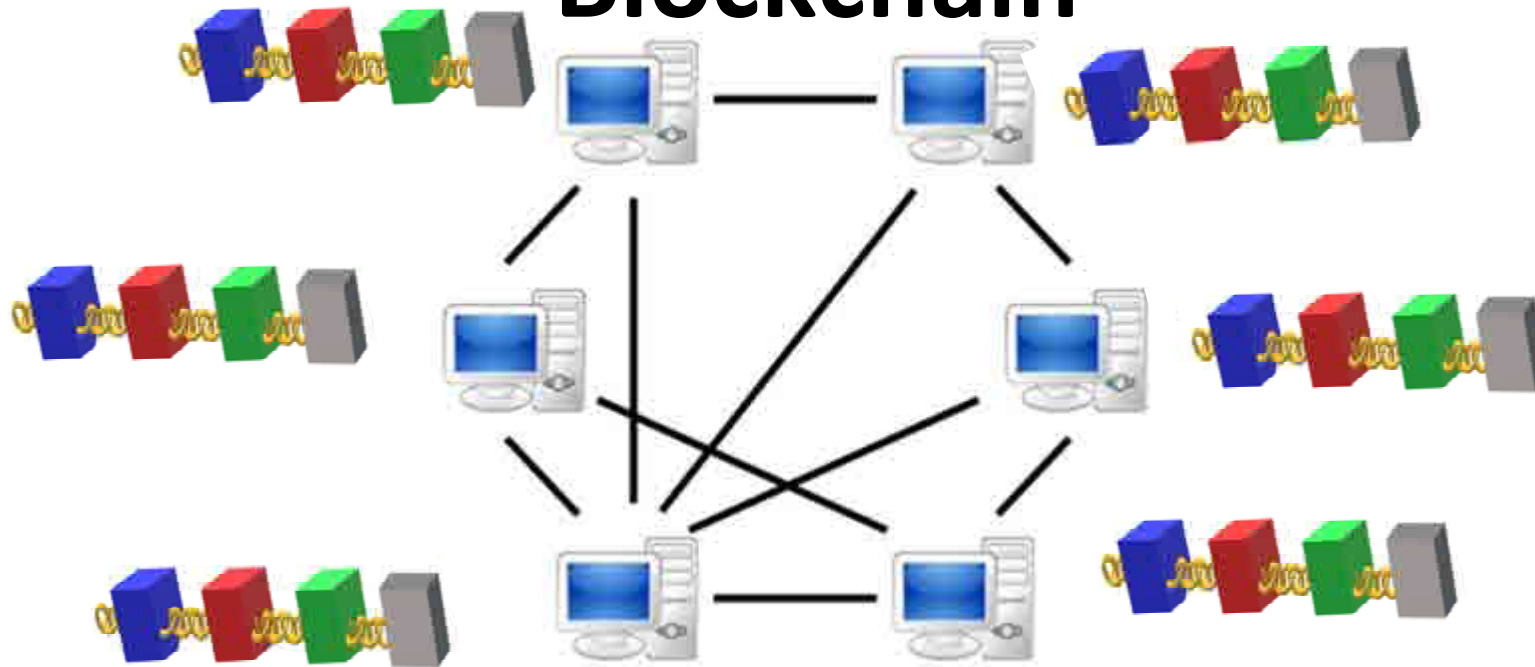
DISTRIBUTED & DYNAMIC

- No central single ledger, which would be vulnerable to being changed
- Peer to Peer Network constantly communicating
- Everyone joining gets a full copy of the chain & the next new blocks as they are added

Blockchain



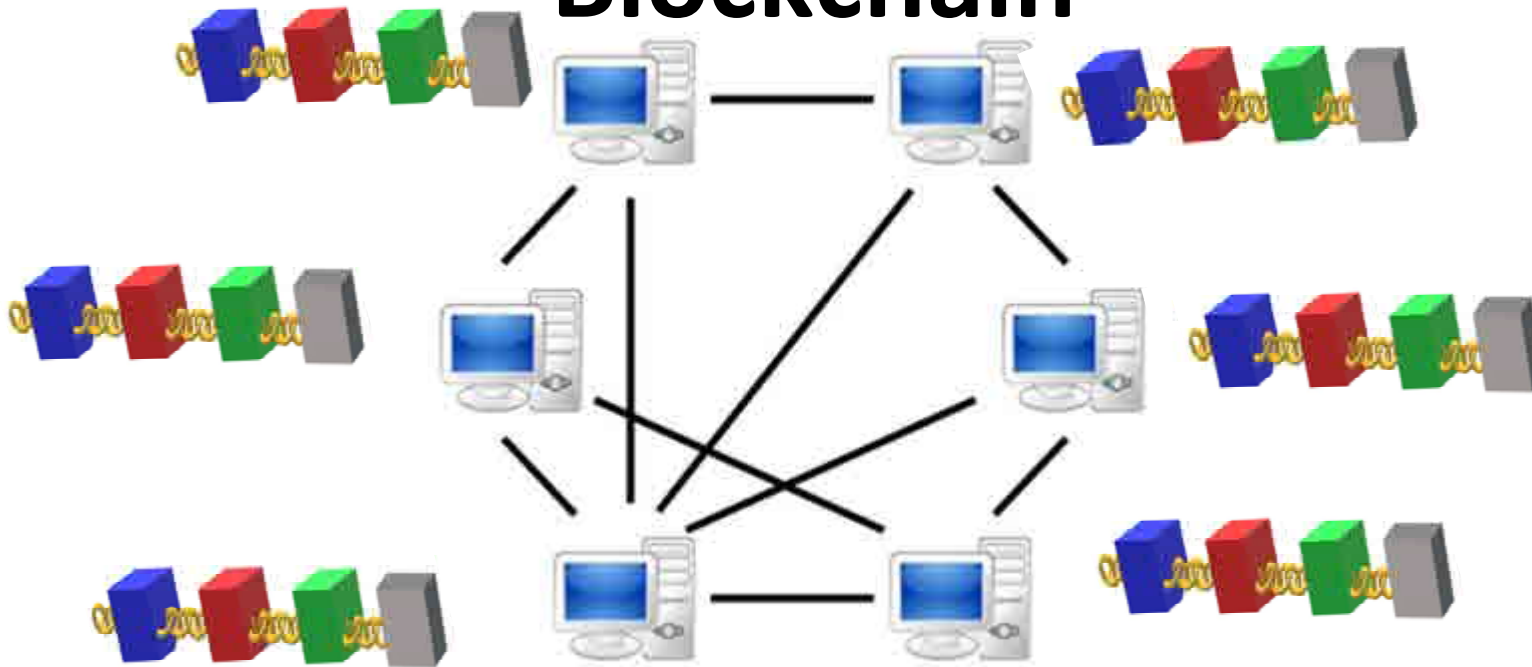
Blockchain



CONSENSUS

- Independently agree which blocks are valid
- Invalid blocks are rejected and replaced
- To have a tampered block accepted, you have to redo all the blocks on the chain, redo the proof of work and take control of over 50% of the network

Blockchain



SMART CONTRACTS

Are programs within a data block that set conditions

Blockchain secures documents but what if someone physically swops ingredient/product containers?



SigNature[®] Naturally Linking the physical world to Blockchain's data world

molecular tags

www.adnas.com



Someone requests a transaction.



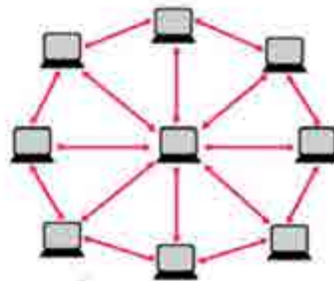
Purchasing a raw material
Uniquely coded SigNature Molecules are included in the material at Parts Per Trillion

Unique code of the SigNature Molecule is included in the Blockchain data

PCR



The transaction is complete.



The requested transaction is broadcast to a P2P network consisting of computers, known as nodes.

Validation

The network of nodes validates the transaction and the user's status using known algorithms.



A verified transaction can involve contracts, records, or other information.



Once verified, the transaction is combined with other transactions to create a new block of data for the ledger.

The new block is then added to the existing blockchain, in a way that is permanent and unalterable.

The sequence of the SigNature Molecule is embedded in the Blockchain.

Authentication requires the unique SigNature Molecular tag matching the code embedded in the Blockchain to be present.

Authenticating the raw material anywhere along the supply chain and even in the finished product is simple. PCR confirms the unique SigNature Molecule (as recorded in the Blockchain ledger) is present in the material



Secure DNA-Ink Cartridges

only matched cartridge/device will operate



CertainT® enhanced Videojet systems transform inkjet codes into secure supply chain certification tools.

Videojet/Applied 1860M CertainT® Printer



Lot code containing molecular ink
printed with Videojet CIJ printer





Tag



Unique, secure SigNature molecular tags are created. In this model, a ckIN2U-specific tag will be used.

SigNature Molecular tag created and deployed:

- Tag deployed to key active ingredients and conveyed into finished product at time of formulation
- Same tag is deployed to variable content ink (primary and secondary package marking)
- Same tag is in the ink element of secondary package design

Quick screening measures deployed:

- Hidden serial code on secondary package – UV
- Fluorescing molecular pattern on secondary package
- Beacon locked optical marker in molecular pattern on secondary package – decryptant/UV light.
- QR code



Test



Molecular Tag

Tested throughout the supply and distribution chain by trained personnel, a contact inspection firm (UL) or ADNAS personnel.

Forensic Determination:
Authenticity

Quick Screen

(hidden serial number, locked optical marker, QR code)

Tested throughout the supply and distribution chain by trained personnel or contact inspection firm (UL).

Quick Screen for:
Authenticity





Track

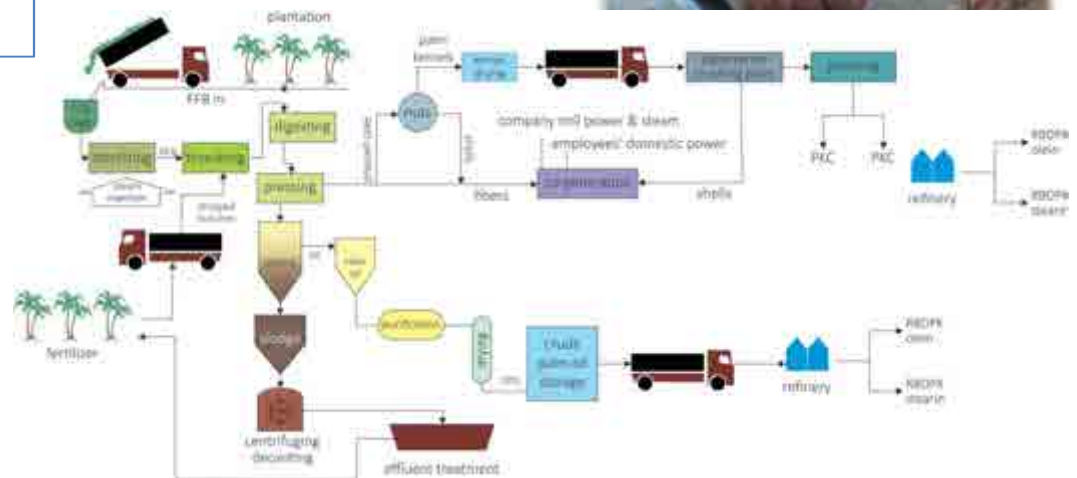
Product activity events relating to the tagged product are captured on a cloud-based database, creating an invaluable history that can be used to identify supply, distribution strengths, vulnerabilities, discrepancies, opportunities for operation cost savings and trends.



**Being certain the
Skin Anti-ageing
product
you formulated
is the one the
consumer is using**

**Securing Supply
Chains
Will Really Make a
Difference**

**Secure Supply
Chains Can
Save
Rainforests!**



Genuine Beauty.

DNA makes it possible to assure
authenticity,
**YOUR ANTIAGING FORMULA IS
THE FORMULA THE CONSUMER
IS USING**
ingredient content,
organic sourcing,
ethical sourcing,
sustainability,
trace-to-source transparency.



Thank you.

applieddnasciences The logo for Applied DNA Sciences, featuring a stylized DNA double helix structure with three horizontal lines extending from the right side.

Dr Barbara Brockway
Director Personal Care
Applied DNA Sciences

www.adnas.com