

References:

1. Ogwumike OO. Hemopoietic effect of aqueous extract of the leaf sheath of *Sorghum bicolor* in albino rats. *African Journal of Biomedical Research*. (2002): Vol 5; 69 - 71
2. Erah PO, Asonye CC, Okhamaf AO. Response of *Trypanosoma brucei brucei*-induced anaemia to a commercial herbal preparation. *African Journal of Biotechnology* Vol. 2 (9), pp. 307-311, September 2003.
3. Oladiji AT, Jacob TO, Yakubu MT. Anti-anaemic potentials of aqueous extract of *Sorghum bicolor* (L.) moench stem bark in rats. *Journal of Ethnopharmacology* Vol. 111, pp. 651-656, 2007.
4. Nwinyi FC, Kwanashie HO. Evaluation of aqueous methanolic extract of *Sorghum bicolor* leaf base for antinociceptive and anti-inflammatory activities. *African Journal of Biotechnology*, 8 (18), 4642-4649, 2009.
5. Eniojukan JF, Aina BA. Toxicological Profiles of Commercial Herbal Preparation, Jobelyn. *International Journal of Health Research*, 2(4), 369-374, 2009.
6. Akande IS, Oseni AA, Biobaku OA. Effects of aqueous extract of *Sorghum bicolor* on hepatic, histological and haematological indices in rats. *Journal of Cell and Animal Biology* 4(9), 137-142, 2010.
7. Kayode APP, Nout MJR, Linnemann AR, Hounhouigan JD, Berghofer E, Siebenhandl-Ehn S. Uncommonly High Levels of 3-Deoxyanthocyanidins and Antioxidant Capacity in the Leaf Sheaths of Dye Sorghum. *J. Agric. Food Chem.* 2011, 59, 1178–1184.
8. Geera B, Ojwang LO, Awika JM. New Highly Stable Dimeric 3-Deoxyanthocyanidin Pigments from *Sorghum bicolor* Leaf Sheath. *Journal of Food Science*, 77(5) C566–C572, 2012.
9. Benson KF, Beaman JL, Boxin Ou, Okubena A, Okubena O, Jensen GS. West African *Sorghum bicolor* leaf sheaths have anti-inflammatory and immune-modulating properties in vitro. *J Med Food*, in press.



HEALTH FOREVER

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JOBELYN™

A West African Sorghum-based Traditional and Multifunctional Nutritional Formulation



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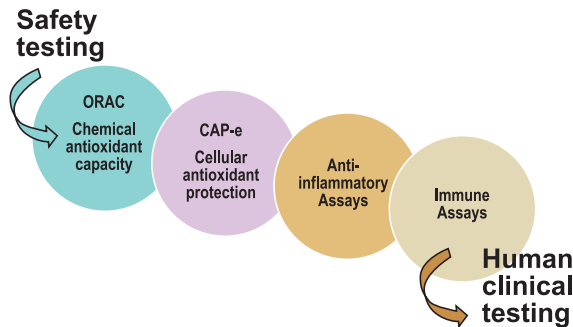




**Jobelyn™** is produced from the colorful leaf base (sheath) of a recently domesticated West African variant of Sorghum bicolor, with unusual high antioxidant and anti-inflammatory properties, due to its unique chemistry.

**Jobelyn™** has gone through extensive analytical testing, and selected biological activities have been proven in a panel of bioassays in vitro. **Jobelyn™** has shown safety in animal studies and shown clinical effects in human clinical trials.

Our goal is to advance **Jobelyn™** from a traditional medicinal product to being accepted as a modern nutraceutical product. Science-based support of **Jobelyn™**'s effects will help build credibility and increased acceptance of this important bioactive product.



## A powerful antioxidant and natural colorant

- ORAC 37,000 µM TE/gram, many-fold higher than most other natural products
- 4% of dry weight consists of 3-deoxy-anthocyanidin, an intense red colorant
- Both the aqueous and ethanol extracts of **Jobelyn™** protect living cells from oxidative damage in the CAP-e bioassay



## Anti-inflammatory properties

- Selective COX-2 inhibition
- Inhibition of free radical formation by inflammatory cells
- Inhibition of inflammatory migration of cells in response to Leukotriene B4

## Immune modulation

### Immune cells

1. Express receptors on cell surface to receive signals
2. Excrete compounds to send signals to other cells

### **Jobelyn™** impacts immune cell modulation in vitro:

- Activates natural killer cells, T lymphocytes, and monocytes
- Increases production of selected immune-regulatory cytokines
- Increases production of anti-viral chemokines MIP-1a, MIP-1b, and RANTES

### **Jobelyn™** supports selected aspects of cellular production:

- Stimulates red blood cell production
- Increases production of CD4 T cells in HIV+ patients





## Potential as a Natural Food Colorant

**Jobelyn™** is produced from a unique variety of *Sorghum bicolor*, recently domesticated from a West African wild variety, representing original genetic makeup and not a result of intense breeding efforts. Many parts of the Sorghum plant have been used for consumption. These include the seeds, leaves, leaf sheathes, stems, and root. **Jobelyn™** is an extract derived specifically from the intensely colored leaf sheathes. **Jobelyn™** is GRAS-certified by the FDA.



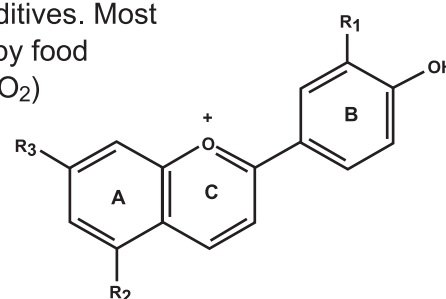
*Sorghum bicolor* is a species of grass, traditionally cultivated for its nutritious grain. Sorghum is now grown in many tropical and subtropical regions of the world, and is gaining increased popularity as a non-gluten grain. Historical uses of Sorghum include food, hot teas, beers, and traditional medicinal extracts.

**Health benefits include:**

- Multi-facetted anti-inflammatory properties
- Immune activation
- Hematopoietic effects
- Pain reduction

**Jobelyn™** has an unusual chemical profile compared to other variants of *Sorghum bicolor*. It has a very high content of unique antioxidant polyphenols, including unique dimeric 3-deoxyanthocyanidins.

The 3-deoxyanthocyanidins in **Jobelyn™** have been studied at the University of Texas A&M, and found to be highly stable, and possess a great resistance to denaturation by low pH or certain food additives. Most anthocyanins are degraded by food additives such as bisulfites (SO<sub>2</sub>) and ascorbic acid.



**Jobelyn™** contains high amounts of anthocyanidins, including the two 3-deoxyanthocyanidins:

Apigeninidin and luteolinidin. A total content per dry weight of 3-deoxyanthocyanidins exceeds 40,000 µg/g, equaling over 4% of the dry weight of **Jobelyn™** (Table 1).



Table 1. Known polyphenol colorants in Jobelyn™

	µg/g	Phenolic class
Naringenin	130	Flavanone
Apigeninidin	39,900	3-deoxyanthocyanidin
Luteolinidin	450	3-deoxyanthocyanidin
Apigenin	6,910	Flavone
Luteolin	570	Flavone



# JOBELYN™

## A West African Sorghum-based Traditional and Multifunctional Nutritional Formulation

**Jobelyn™** is produced from a unique variety of *Sorghum bicolor*, recently domesticated from a West African wild variety, representing original genetic makeup and not a result of intense breeding efforts. Many parts

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**Jobelyn™** is GRAS-certified by the FDA. **Jobelyn™** has a unique chemical profile compared to other variants of *Sorghum bicolor*. It has a very high content of unique antioxidant polyphenols, including 3-deoxyanthocyanidins with a great resistance to denaturation by low pH or certain food additives.



### Science behind **Jobelyn™**

The antioxidant capacity of **Jobelyn™** is very high, with a total ORAC score of 37,000 µM TE/gram of dry powder. This protection includes quenching of both peroxy and hydroxyl free radicals, as well as singlet oxygen and a high capacity of quenching superoxide anions.

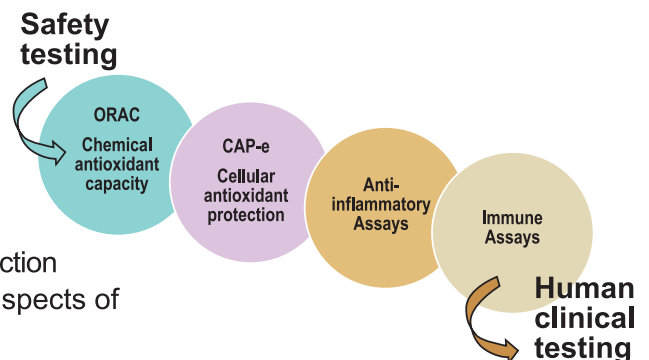
The quenching of peroxy free radicals by **Jobelyn™** is over 3,500 µM TE/gram, almost 4 times higher than high quality Acai products, and 50 times higher than tart cherries.

The anti-inflammatory properties of **Jobelyn™** include:

- Selective COX-2 inhibition
- Re-programming of inflammatory cells to reduce the production of free radicals (Reactive Oxygen Species) and other aspects of inflammatory behavior

The immune modulating properties of **Jobelyn™** were tested in vitro and include:

- Activation of Natural Killer cells, T lymphocytes, and macrophages
- Unique and selective increases of specific immune regulatory and antiviral cytokines and chemokines



# Antioxidant capacity and cellular protection by the West African sorghum-based product

# JOBELYN™

**Jobelyn™** is produced from a unique variety of *Sorghum bicolor*, recently domesticated from a West African wild variety, representing original genetic makeup and not a result of intense breeding efforts. **Jobelyn™** is an extract derived specifically from the intensely colored leaf sheathes. **Jobelyn™** is GRAS-certified by the FDA. **Jobelyn™** has an unusual chemical profile compared to other variants of *Sorghum bicolor*. It has a very high content of unique antioxidant polyphenols, including unique dimeric 3-deoxyanthocyanidins. These compounds contribute to the chemical and biological antioxidant effects.

*Sorghum bicolor* is a species of grass, traditionally cultivated for its nutritious grain. Sorghum is now grown in many tropical and subtropical regions of the world, and is gaining increased popularity as a non-gluten grain. Historical uses of Sorghum include food, hot teas, beers, and traditional medicinal extracts.

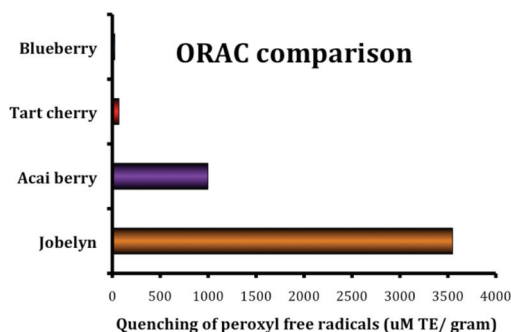
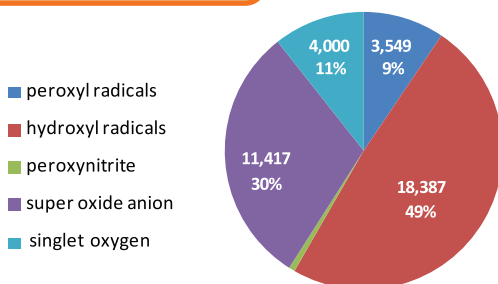
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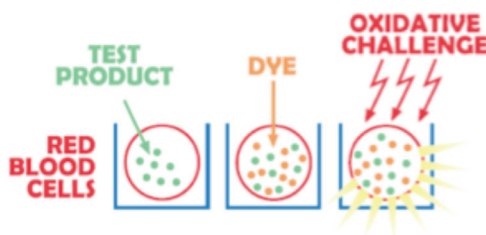
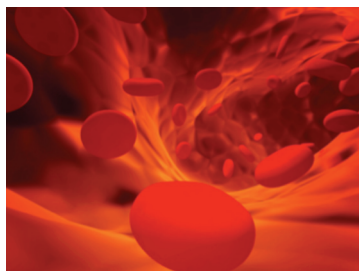
Oxygen is essential for our life. However, oxygen is also used in chemical reactions in our body that produce free radicals, which are harmful, electrically charged ions. Antioxidants are compounds capable of neutralizing free radicals that would otherwise potentially damage cells and tissues. Antioxidants help to prevent damage to cells and tissue, and provide multi-faceted health benefits.

There are different methods to test for antioxidants. Each method provides different information. For this reason, a sequential testing strategy was used.

The Oxygen Radical Absorbance Capacity or 'ORAC' test, is a widely used antioxidant test. It measures chemical antioxidant capacity, and was used to test **Jobelyn™**.



While the ORAC test helps demonstrate whether a product contains chemicals that are able to perform antioxidant reactions, it does not tell us if compounds are functioning as protective antioxidants in biological systems. Because of this limitation of the ORAC test, the Cellular Antioxidant Protection in erythrocytes, or CAP-e, test was also used to test **Jobelyn™**. The CAP-e test directly measures antioxidant uptake and protection at the cellular level.



### DEFINITIONS

#### Free radical:

An atom or group of atoms with at least one unpaired electron. Unpaired electrons are highly reactive and can damage living cells.

#### Antioxidant:

A compound capable of donating an electron and thus neutralizing the electrical charge that may otherwise lead to cascading cellular damage.

**Jobelyn™** showed cellular antioxidant protection capacity in the CAP-e test. The cellular protection seen in the CAP-e assay allows us to conclude that **Jobelyn™** contains antioxidants that are bioavailable and functional at the cellular level. Protection was seen both in the water extract and in the ethanol extract. This suggests a complex range of biologically active antioxidants in **Jobelyn™**.

**Jobelyn™** is produced from a unique variety of *Sorghum bicolor*, recently domesticated from a West African wild variety, representing original genetic makeup and not a result of intense breeding efforts. **Jobelyn™** is an extract derived specifically from the intensely colored leaf sheathes.

*Sorghum bicolor* is a species of grass, traditionally cultivated for its nutritious grain. Sorghum is now grown in many tropical and subtropical regions of the world, and is gaining increased popularity as a non-gluten grain. Historical uses of Sorghum include food, hot teas, beers, and traditional medicinal extracts.

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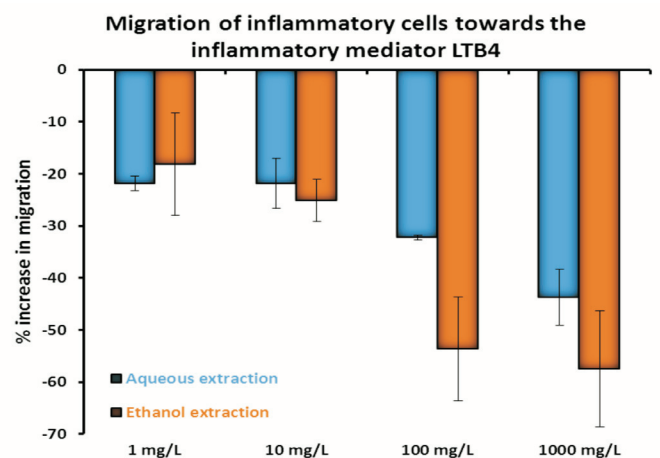
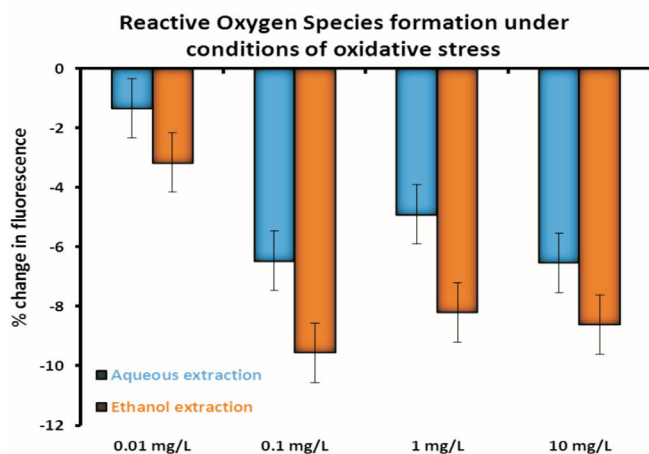
- Multi-faceted anti-inflammatory properties
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Chronic inflammatory conditions underlie many aspects of declining physical and mental health. Comprehensive anti-inflammatory nutritional strategies are increasingly gaining attention for health management.

Inflammation involves multiple pathways, including:

- Production of damaging free radicals
- Infiltration of inflammatory cells into target tissues
- Up-regulation of inflammatory enzymes, such as COX-2



**Jobelyn™** was evaluated in laboratory tests involving separate mechanisms of action. **Jobelyn™** contains a complex array of compounds with different chemical properties that inhibit free radical production, reduce infiltration of inflammatory cells, and inhibit COX-2 enzymatic activity. This suggests a multi-faceted anti-inflammatory capacity of **Jobelyn™**.



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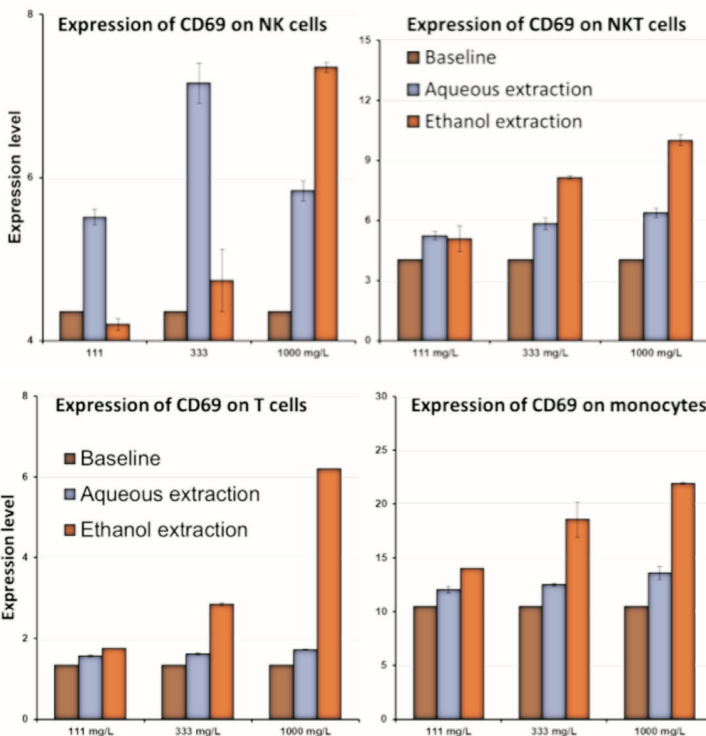
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**Jobelyn™** is GRAS-certified by the FDA. **Jobelyn™** has an unusual chemical profile compared to other variants of *Sorghum bicolor*. It has a very high content of unique antioxidant polyphenols, including unique dimeric 3-deoxyanthocyanidins. Given the traditional use of Sorghum-based products, including teas, in prevention of viral illness, **Jobelyn™** was tested for immune activating properties in laboratory tests.

Our immune system is not limited to a given organ or tissue, but is widespread throughout our body, blood, skin, and mucosal barriers. Immune cells, when activated, communicate in various ways by:

- Expressing receptors on cell surfaces to receive signals
- Secreting compounds to send signals to other cells.



Cytokine	Fold Increase
IL-1R alpha	8
IL-6	174
IL-7	6
IL-8	13
IL-10	15
IL-12	5
IL-13	5
IL-15	9
MCP1	145
MIP-1alpha	241
MIP-1 beta	168
RANTES	2
IFN-alpha	12

**Jobelyn™** treatment of human immune cells resulted in increased expression of the CD69 activation marker on the cell surface of Natural Killer cells, NKT cells, T lymphocytes, and monocytes. The cytokine profile in these cell cultures showed up-regulation of multiple cytokines, including several chemokines known to be involved in anti-viral immune defenses.