



Accumulation Trend of L-Dopa in Different Plant Parts of Fava Beans Varieties

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Introduction:

- Fava Bean (*Vicia Faba* L.), commonly known as broad bean, field bean, bell bean is a member of Fabaceae. It is a legume originally from North Africa and Southwest Asia.
- Among different pulses, Fava Bean is currently receiving global attention as it is a good source of proteins, carbohydrates, fiber, minerals and secondary metabolites such as phenolic compounds. Type, quality and quantity of fava beans metabolites, that can be used in food and medicinal industries, may change with its growth stage and plant parts.
- Fava Beans contain high amounts of phenolic content which can elevate L-Dopa (L-dihydroxyphenylalanine) in blood. L-Dopa is a neurotransmitter precursor which is considered as an effective remedy for the relief in Parkinson's disease.
- L-Dopa is also a useful drug for myocardium following neurogenic injury. It is conventionally used to increase dopamine concentrations in the brain.
- Most of studies have been focused on L-Dopa content in dry seeds (Shetty et al., 2001). Limited information is available on L-Dopa content of other parts of the plant.

Research Goals:

The main goal of this study was to determine:

- L-Dopa concentration in different organs including root, stem, leaf, bud and seed of Fava Beans (Windsor variety) in field condition.
- accumulation trend of L-Dopa in different seedling stages of eight fava bean varieties in greenhouse condition.

Materials and Methods:

Field Experiment

- Seeds of Fava Bean (Windsor variety) were planted at the University of Massachusetts Crops and Animal Research and Education Center in South Deerfield on August 1, 2013.
- Ten plants were harvested at following stages, separated into different parts and analyzed for L-Dopa:
 - Seedling stage (20 DAE).
 - Flowering stage (60 DAE).
 - Pod ripening stage (90 DAE).
- At each harvest, plants were washed and separated into different parts. Samples were separately oven dried for 36h at 55° C. Dried samples were ground fine to pass through a 0.42 mm screen before extraction.

Greenhouse Experiment

- A Complete randomized design with three replications was used.
- Seeds of 8 varieties (bell bean, early violetto, aquadulce, delle cascine, windsor, sweet lorane, early white, D'Aquadulce) were grown in trays 10" x 20" filled with potting soils.
- Three plants were harvested six times during early vegetative stage. Samples were oven dried for 36h at 55° C. Dried samples were ground fine to pass through a 0.42 mm screen before extraction.
- 200 mg of dried samples was immersed in 95% ethanol and kept in freezer for 72 hrs. Samples then were homogenized using a tissue tearer.
- Samples were centrifuged at 13,000 rpm for 10 min. The liquid portion was left under hood until ethanol was evaporated. The residue was dissolved in buffer solution and left in fridge until particles settled.
- The supernatant was passed through a 0.45 µm syringe filter and analyzed using HPLC.

Calibration Curve

Four concentrations of stock solution (50, 100, 200, 400 ppm) were diluted and injected with mobile phase. The calibration curve was obtained by plotting the absorbance area versus the concentrations of the standard solution (Figure 1).

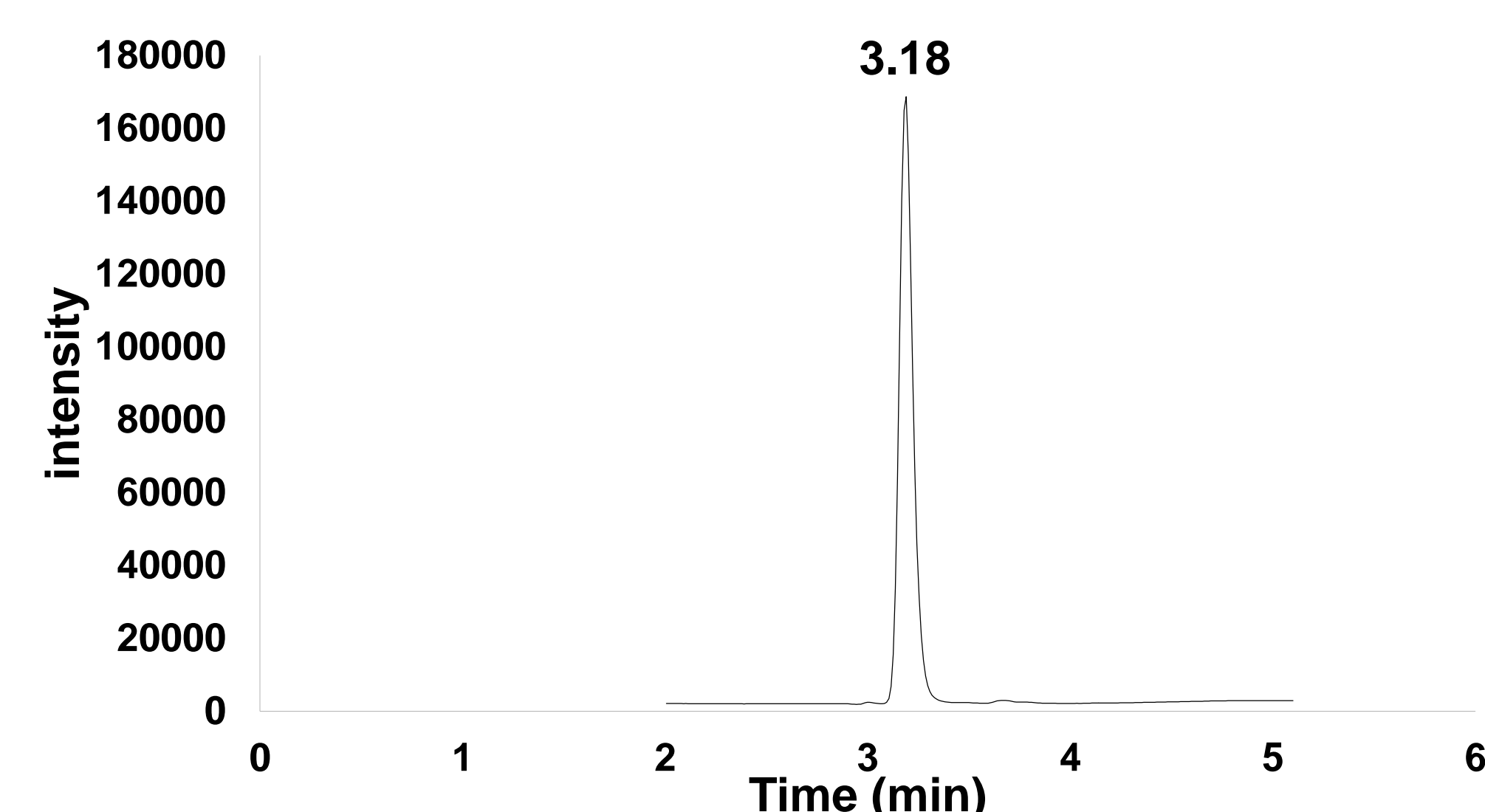


Figure 1. HPLC chromatogram of L-Dopa standard solution

Table 1. The concentration of L-Dopa in different Fava Bean parts grown in field condition.

	Seedling	Root	Stem	Leaf	Bud	Seed
Levodopa (mg g ⁻¹)	13.3	6.5	3.5	10.5	9.5	7.2

Table 2. Concentration of L-Dopa in different seedling stage of eight Fava Beans varieties

	Bell Bean	Early Violletto	Aquadulce	Delle Cascine	windsor	Sweet Lorane	Early White	D'Aquadulce
Seedling (leaf #)	L-Dopa Concentration (mg g ⁻¹)							
protrude	8.6	7.8	5.5	10.5	3.3	5.9	10.6	5.7
2	15.0	16.6	10.5	10.7	10.5	14.2	13.6	12.7
4	16.7	7.9	12.5	12.7	12.5	13.9	13.5	16.3
6	11.3	4.8	9.1	8.0	9.2	9.9	8.8	10.0
8	10.2	6.5	9.2	8.3	10.3	8.6	9.3	8.5
10	9.8	5.6	8.9	7.3	10.1	8.5	8.0	7.4

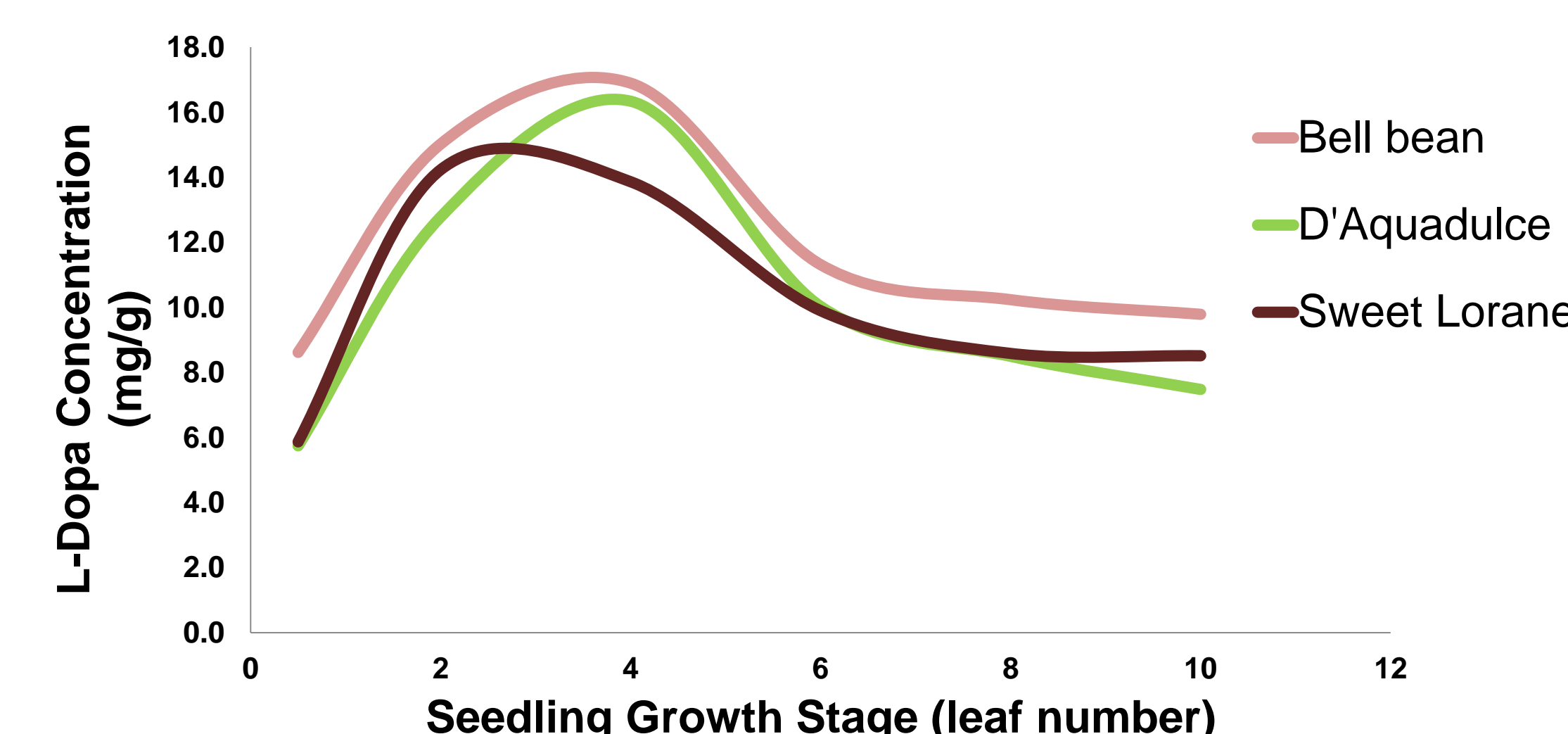


Figure 2. Accumulation trend of L-Dopa in different seedling stages of three fava beans varieties

Results and Discussion:

- Results of the study revealed that Fava Beans contain significant amount of L-Dopa required for remediation of Parkinson's disease.
- Seedling (13.3 mg g⁻¹) and stem (3.5 mg g⁻¹) were the richest and poorest sources of L-Dopa, respectively (Table 1).
- Leaves and terminal buds were also rich in L-Dopa with 10.5 and 9.5 mg g⁻¹, respectively.
- In all varieties the peak concentration of L-Dopa was obtained between 2-4 leaf stages and showed declining trend there after.
- Varieties used in this study had different L-Dopa content where Bell Bean had the highest (16.7 mg g⁻¹) and Aquadulce had the lowest (12.5 mg g⁻¹) concentrations of L-Dopa.
- Recent report (Mohseni and Golshani; 2013) indicated that in the treatment of Parkinson's disease, consumption of large quantities of unsprouted fava beans seeds may cause flatulence in the patients.
- Consumption of just sprouted fava beans seeds as opposed to seeds (fresh or dry) with higher L-dopa content would be a preferred option.
- The result of the current study revealed that seedlings and leaves of fava beans are considerably richer in L-Dopa than seeds without the flatulence issue associated with consumption of the seeds.

Reference:

- Mohseni Mehran S.M., B. Golshani. 2013. Simultaneous Determination of Levodopa and Carbidopa from Fava Bean, Green Peas and Green Beans by High Performance Liquid Gas Chromatography. J. Clinical and Diagnostic Res. 7(6): 1004-1007.
- Preethi Shetty, Mokhtar T Atallah, and Kalidas Shetty. 2001. ENHANCEMENT OF TOTAL PHENOLIC, L-DOPA AND PROLINE CONTENTS IN GERMINATING FAVA BEAN (VICIA FABA) IN RESPONSE TO BACTERIAL ELICITORS. FOOD BIOTECHNOLOGY, 15(1), 47-67.

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