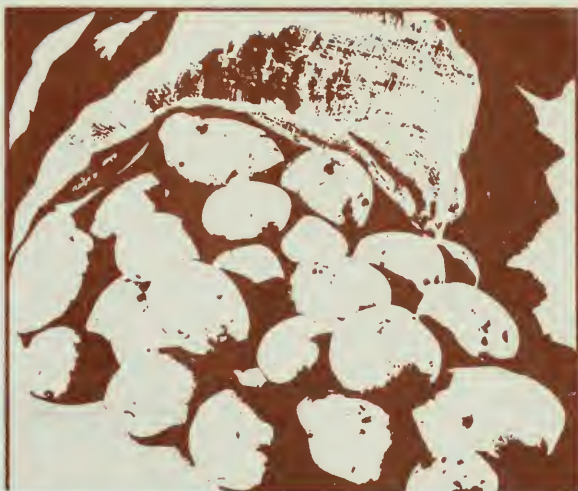


TGA in potatoes



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The family Solanaceae, to which the potato belongs, is noted for the many alkaloids found in its various species. An alkaloid is a basic nitrogen compound that occurs in plants, and a glycoalkaloid is an alkaloid that has one or more sugar molecules attached to it. The cultivated potato, *Solanum tuberosum*, contains two main glycoalkaloids, solanine and chaconine, which are derived from the same parent alkaloid, solanidine. These compounds are commonly referred to as TGA (total glycoalkaloids).

In small amounts, TGA is a normal constituent of potato tubers. It is partly responsible for their characteristic flavor, and it may also be a factor in protecting plants from insects and other predators. In above-normal amounts, TGA gives tubers a bitter taste, and under unfavorable circumstances it may reach a toxic level.

Bitterness or high TGA levels in potato tubers can be readily detected by chewing a small piece of the raw peel, about 1/8 inch (3 mm) thick. TGA levels of more than 10 mg/100 g of potato (or 100 ppm) cause a slowly developing, hot, burning, persistent irritation at the sides of the tongue and the back of the mouth. The sensation, not unlike one from hot peppers, usually develops within 15 to 30 seconds. Although individuals have different thresholds of perception, normal levels of TGA of less than 10 mg/100 g are usually not detectable by taste. At the other extreme, potatoes containing more than 20 mg/100 g give an immediate burning sensation and are considered unfit for human consumption.

Eating green potatoes that contain high levels of TGA has caused severe illness in humans, and feeding potato vines, sprouted or cull potatoes, or peels high in TGA has resulted in losses of livestock and poultry. It has been suggested that acute illness induced by TGA is more prevalent than is indicated by the few recorded medical cases. The symptoms are common to many ailments and can be easily mistaken for a severe digestive discomfort (gastroenteritis) with nausea, diarrhea, vomiting, stomach cramps, headaches, and dizziness. An important point to note is that TGA is not destroyed by cooking; therefore, the only effective way to avoid its intake is to prevent it from forming in the tubers.

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In most instances tubers contain low levels of TGA at the time of detachment from the vine (2 to 8 mg/100 g). Mechanical or chemical vine killing, frost, daylength, and soil type are believed to have almost no influence on TGA buildup. The concentration is, however, affected by the maturity of the tuber, as glycoalkaloids are formed quite early during a tuber's development and then are diluted as it enlarges. As most of the TGA is usually concentrated in about a 1/16-inch (1.5-mm) layer under the potato skin (60% to 80% in normal tubers), the edible part of a peeled tuber contains TGA levels well below 5 mg/100 g. Peeling thus removes most of the offending substances, unless prolonged storage has permitted them to spread gradually toward the center of the tuber. In very bitter tubers, as little as 30% to 35% of TGA is removed by peeling.

In some cases high TGA levels have been found to be caused by the environment after harvest. Netted Gem potatoes, for example, can triple their TGA content after 6 to 8 hours of exposure to sunlight under conditions of near-freezing temperatures. Other factors that may contribute to high TGA levels are: mechanical injury, illumination of tubers during early storage, and high temperatures in excess of 50°F (10°C) during harvest and storage. Also, some varieties of potatoes apparently can develop high levels of TGA more easily than others; for example, Irish Cobbler does not respond to exposure to light, but Katahdin and Kennebec double their TGA content during 96 hours of illumination under 75 foot-candles (807 lux) of fluorescent light.

Usually there is a relationship between greening of tubers and TGA levels, although the processes of chlorophyll development (greening) and TGA formation are independent. The greening of tubers is also a characteristic of certain varieties; some turn green more readily than others, and slight greening of tubers exposed to fluorescent light in retail stores does not necessarily mean high TGA levels.

After harvest there is a slight but definite increase of TGA in dark storage, and for a short time after harvest tubers are very responsive to conditions that favor TGA formation. Note that light-induced TGA formation will continue for some time after tubers are transferred to storage in darkness, which normally does not favor development of TGA. Affected tubers often begin to sprout, even at 40°F (4.4°C). Older and nondormant tubers show an irregular response.

Bruising, cutting, or skinning potatoes during handling may be a significant factor in TGA buildup. An increase of up to 120 mg/100 g near a wound has been reported. However, when tubers high in TGA are replanted, they will produce new tubers with normal levels.

The following are recommended procedures to control TGA levels in tubers:

- Keep tubers well covered with soil during the growing period.
- Allow the tubers to mature before harvesting.
- If possible, avoid harvesting potatoes on a clear, sunny day when the temperature is near freezing, or may drop to near freezing.
- Do not leave potatoes to dry in the field on a clear, cold, sunny day.

- Discard sunburned tubers.
- Avoid handling methods that cause bruising or skinning of tubers.
- Store potatoes in the dark at temperatures between 40 and 50°F (4.4 and 10°C).
- Expose tubers to the least possible amount of light during grading and other operations.
- Avoid the use of transparent plastic bags, especially for washed and brushed potatoes.
- Store tubers under proper conditions in supermarkets and in the home. If tubers are displayed in transparent plastic bags, the length of time they are under light should be kept to a minimum.

If potatoes are thought to contain high levels of TGA, consult the nearest Fruit and Vegetable Inspector before sale or use.

TGA LEVELS IN WHOLE POTATO TUBERS, mg/100 g FRESH WEIGHT

Variety	Average TGA	Range of TGA
Kennebec	9.7	4.0–35
Netted Gem	7.9	3.0–18
Katahdin	7.9	2.3–21
Irish Cobbler	6.2	2.6–15
Red Pontiac	4.3	1.4–8.1

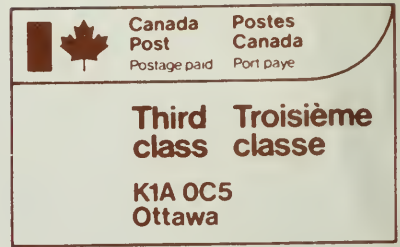
DISTRIBUTION OF TGA IN THE POTATO PLANT, mg/100 g FRESH WEIGHT

Sprouts	200–400
Flowers	300–500
Stems	3
Leaves	40–100

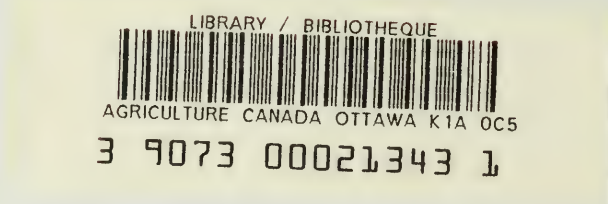
NORMAL TGA LEVELS IN VARIOUS TUBER TISSUES, mg/100 g FRESH WEIGHT

Skin, 2–3% of tuber	30–60
Peel, 10–15% of tuber	15–30
Peel and eye, 1/8-in. (3-mm) disk	30–50
Peels from bitter tubers	150–220
Flesh	1.2–5
Whole tuber	7.5
Bitter tubers	25–80

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