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Mini Review

Biotechnological potentials of *Seidlitzia rosmarinus*: A mini review

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***Seidlitzia rosmarinus* is a perennial woody plant grown mostly along the banks of salt marshes and in soils with high saline water tables. This plant being a halophyte is very well adapted to grow in dry and salt affected desert soils. It plays an important role in both soil preservation and maintenance. The leaves, stems and seeds harvested in fall are used as fodder for livestock. Ashes remaining after burning the leaves and stems make a salt which is rich in sodium carbonate and is called "Karia" or "Caria" in Iran. When dissolved in water, Karia produces a soda also called "Ghalyab". The dried leaves powder is used as detergent for washing cloths and dishes. It has also many industrial applications such as dyeing, making soaps, pottery and ceramics among others. Besides being used as fodder in dry and desert regions, its "Ghalyab" can be used in biotechnological studies. Cultivation of *S. rosmarinus* plants in salt affected and dry farm lands for "Ghalyab" production has economical values.**

Key words: *Seidlitzia romarinus,* biotechnology, salt tolerance, soda, forage.

INTRODUCTION

Seidlitzia rosmarinus is a perennial woody plant well adapted to grow along the banks of salt marshes and also in saline soils (Breckle, 1986; Hedge et al., 1997). It is used both as fodder for camel (Koocheki and Mahalati, 1994) and being resistant to high salinity (Kurkova et al., 2002; Hadi et al., 2007) it plays an important role in soil preservation in desert and dry land regions (Koochekei and Mahalati, 1994; Jafari et al., 2003). This plant grows wild abundantly in salt affected soils of Qom Province in central part of Iran (Jafari et al., 2003). The ashes left after burning the leaves and stems of *S. rosmarinus* is called "Karia" or "Caria" in Iran (Hadi et al., 2007) and is rich in sodium carbonate (Na_2CO_3) and when dissolved in water produces a soda called "Ghalyab" or "Kalyab". The soda has many industrial and nutritional values and the plant itself being a highly salt tolerant is a very useful tool in biotechnological investigations (Hadi and Sharif, 2003).

SALT TOLERANCE CHARACTERISTICS OF *S. rosmarinus*

Salinity of arable lands is a global problem which has affected 955 million (7%) hectares of total world land surface (Ghassemi et al., 1995; Farooq and Azam, 2005). In Iran, the areas affected by mild and moderate salinity are about 25.5 million hectares and those severely affected cover about 8.5 million hectares (Siadat et al., 1997; Kehl, 2006). The majority of plants grown in these areas are *Seidlitzia, Chenepodium* and *Salicornia* whose developments are negatively affected by high concentrations of salts. In these areas the adverse salt effects on plants growth are caused by an osmotic effect that is low soil solution osmotic potential, nutritional imbalance caused by specific ion effects and by the combination of these two factors. The extent to which salt damages plants depends on plant species, salt composition and salt concentration (Huang and Redmann, 1995; Ashraf and Harris, 2004). The main problems affecting arable lands are the alarming rates of salinity due to mismanagement in irrigational practices and lack of well defined plant indicators at plant breeders' disposal to be used in studies dealing with breeding salt tolerant agricultural crops (Ashraf and Harris, 2004). Using salt tolerant plants will play an important role in elucidating the mechanism(s) involved in plant salt tolerance. The *Chenopodiaceae* families with 321 species, halophyte having the highest number of genera including *S. romarinus* (Repo-Carrasco et al., 2003). Although nutritionally is not very valuable, it is still used as forage for camels (Koocheki and Mahalati, 1994; Hadi et al., 2007). It is highly adaptable to abiotic stresses such as high temperatures, drought and salinity. Under saline conditions, *S. rosmarinus* accumulates salt ions and synthesizes amino acid proline, to counteract the salt stress effects inside the cells and also to maintain leaf tissues water content (Hadi et al., 2007). The effects of salts on *S. rosmarinus* seed germination have been studied. The lowest germination rates took place at 400 mM NaCl (Hadi et al., 2007). At 300 mM NaCl and after 7 days, 75% of the seeds germinated. The Seeds of *S. rosmarinus* germinated extraordinary only in concentration of 25 mM $NaNO_3$ whereas in other salts such as NaCl, $NaNO_3$, KCl, KNO_3 can germinate in concentration of 400 mM (Hadi et al., 2007). In these studies, seed size did not have any effects on their resistance to salinity during germination. The effects of NaCl, $NaNO_3$, KCl, KNO_3 and polyethylene glycol (PEG) on seedlings growth and their proline contents were significant (α = 1%). With the increase in the amount of salts in the media, there was a decrease in the rates of both seed germination and seedling growth and also an increase in the amount of tissues proline contents. The responses of *S. rosmarinus* to 500 mM NaCl solutions have been studied during a period of 72 h (Kurkova et al., 2002). In these studies three phases of physiological responses were identified. Concomitant studies of physiological parameters and cells ultrastuctural changes allowed the investigators to conclude that *S. rosmarinus* resists salt stress by changing its osmoregulatory systems (ionic and organic osmolytes). They also found that salt ions are accumulated in leaf and root cells vacuoles by pinocytosis and also in other small cytoplasmic vesicles. In Iran, *S .rosmarinus* grows in saline soils of Qom Province (Jafari et al., 2003). This species also grows in Isfahan Province (central Iran) especially in the vicinity of Gave-Khooni salt marsh (Hadi and Sharifi, 2003; Hadi et al., 2007). High soil pH and lime contents stimulate its growth, whereas high bicarbonate ions have inhibitory effects. Based on findings reported so far, *S. romarinus* plants are highly halophytic and xerophytic and have genes responsible for these traits. It can serve as a valuable tool for plant breeders in producing crops resistant to salt and drought stresses.

NUTRITIONAL VALUES

S. romarinus has been used as forage for a long time (Koocheki and Mahalati, 1994). Although the nutritional values of halophytes such as *S. rosmarinus* are relatively good, they make palatable forage when mixed with other pasture plants (Swingle et al., 1996). *S. rosmarinus* and other halophytes accumulate a large amount of salts in their tissues. It has been reported that high leaf salt content does not have any adverse effects on animals digestive systems (Moore et al., 1985) though they may be less acceptable by animals as the sole source of food (Wilson, 1977). Accumulation of Cu and Mn at non-toxic levels by *S. rosmarinus* has been reported to be safe for sheep and cattle (Al-Khateeb and Leilah, 2005). It has also been reported that this plant has medicinal properties and is used for the treatment of some acnes (Parsa, 1960).

INDUSTRIAL USES

In ancient times, Iranian used to make holy bonfire using plants growing in saline soils. They were using *S. rosmarinus* ashes as detergent to wash their bodies and their clothing. When mixed with oil or suet, it makes high quality soap. Today, this plant ash is a source of alkaline materials (in Iran known as "Ghalyab or "Kalyab") used in soap and detergent industries. The ash has also antiseptic and antibacterial properties. Root tissues of *S. rosmarinus* have a high capacity to absorb large amounts of soil alkali metals such as Na^+ and K^+ which are subsequently transferred to the shoots. It seems the main mechanism of salt resistance in this plant is tolerance. Large amount of sodium is accumulated in cells vacuoles. The ash contains a large amount of sodium and potassium carbonates. These carbonates are also present in the ashes of plant materials rich in organic salts. Today, in Iran as much as 26 tons of alkali ("Ghalyab") is produced annually from *S. rosmarinus* grown wild in saline soils of Qom Province.

THE ROLES IN ENVIRONMENTAL PROTECTION

S. rosmarinus is a perennial shrub and the *Seidlitzia* genus belongs to *Chenopodiaceae* family (Hedge et al., 1997). The plants grow up to 2 m tall with a canopy diameter of 1.5 m. The leaves are cylindrical and succulent. It tolerates high amount of salts in the soil and also thrives very well in soils with high alkalinity. It is also a drought resistant plant and grows very well in low rainfall desert ecosystems. It can also be used as windbreak. *S. rosmarinus* is indigenous to Iran and is a dominant plant in saline soils and desert habitats such "Kavir-e-Lut", "Dasht-e-Kavir" "Hoz-e-Soltan" lake and Qom Province all in central part of Iran. It has also been found in "Ghav-Khooni" salt marsh of Isfahan Province. According to Qom Province Department of Agriculture, plants such as *S. rosmarinus, Astragalus* and *Ferula gummosa* (known as "Barijeh" in Iran) are the dominant plants grown in Qom Province area covering about 270 ha of land. They are well adapted to these regions which are characterized by low rainfall, very high temperature during the summer and very high soil salt contents. In addition, *S. rosmarinus* plants are not only used as forage to feed livestock and wild animals such as antelopes (Koocheki and Mahalti, 1994), but also can be used for environmental protection and soil erosion control.

CONCLUSION

Based on the above reports, *S. rosmarinus* is a xerophytic desert salt tolerant plant having genes responsible for its resistance to salt and drought stresses. It can serve as a very useful tool in the hands of plant breeders to produce agricultural crops resistant to these stresses. It accumulates copper and manganese at non-toxic levels, has a high level of protein (7%), and 80% digestible organic matters (Koocheki and Mahalati, 1994). With these nutritional properties it can be used as forage for livestock especially for camels in severe dry and saline desert conditions. Further therapeutic properties of this plant should be explored e.g. for the treatment of acnes. The leaves of *S. rosmarinus* accumulate a large amount of soda compounds which can be used in several industries such as making soaps and detergents, pottery, ceramics, in sugar factories (sugar crystalinization), copper bleaching, etc. Its potential in environmental protection such as wind break and preventing soil erosion should not be overlooked.

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