INTRODUCTION

The soil salt of salinity is mostly found as NaCl (sodium chloride) which is one of the most adverse and negative effect causing problems in environmental factors of and ecosystem that caused to reduce crop production and productivity worldwide (Mickelbart, Hasegawa, & Bailey-Serres, 2015; Roy, Negrão, & Tester, 2014). It has been estimated that there is about 20% of all of the irrigated soils of the world which may be increased up to 50% of land growing areas due to changing environmental conditions of the globe. The salinity is causing a loss of about 12 billion US$ each year for agriculture and its products (Munns & Gilliham, 2015; Pitman & Läuchli, 2006). There are two different stages in plants to which the salty stress caused to decrease or effects to block the morphological and physiological functioning of cells. The first one is called as osmotic stress phase under which as there are higher salts concentrations in the soil as compared with the plant root cells caused a reduction of water potential in the soil which caused reduced uptake of water by plant roots (Ali, Rafique, Ali, & Malik, 2020; Miller, Suzuki, Ciftci-Yilmaz, & Mittler, 2010; Munns & Tester, 2008). The osmotic stage starts just after the initiation of the salt stress on plants due to higher salt concentration in the soil. It is mostly independent with the salt concentration or ion concentration in the roots hairs, root tips, or in leaves of plants which may cause the stomata closure under salinity stress conditions. The cation/H⁺ antiporters are involved in the homeostasis of K⁺, Na⁺, and pH of the cell under salinity stress conditions. The cation/H⁺ antiporters help plants cells to regulate all physiological functions under salt stress conditions.

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*) Corresponding author:
E-mail: saim1692@gmail.com

ABSTRACT

Salinity is an important adverse environmental problem that caused a loss in the sense of reducing yield per plant, morphological, and physiological functions of crop plants. The plants compete with environmental stress conditions to withstand following normal growth and development. The exchange of cations or protons (H⁺) takes place across the cell membrane to maintain the osmotic pressure of cells under salt stress conditions. There is a huge number of cation/H⁺ antiporter 1 protein-producing gene by plant cells under salt stress conditions has been identified. However, a few have been characterized and sequenced which contributes to ion homeostasis and osmotic adjustment of cells. These cation/H⁺ antiporters are produced and stored in the vacuoles, endosomal forms and in the cytoplasm. The cation/H⁺ antiporters are involved in the homeostasis of K⁺, Na⁺, and pH of the cell under salinity stress conditions. The cation/H⁺ antiporters help plants cells to regulate all physiological functions under salt stress conditions.

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plants mostly show the stress tolerance mechanisms which may be signals caused by the production of hormones, cation exchange in the cells with the outer environment like the timely transport of Na⁺ in the cells caused reduced cell injury in the root and cells, and tolerance at the tissue level in which the accumulation of Na⁺ takes place in the leaves where the Na⁺ compartmentalization at intracellular and cellular levels take place mostly in the vacuoles of cells for saving cells from higher accumulation of Na⁺ in the cytoplasm and other organelles of the cell. The Na⁺ compartmentalization in vacuoles provides an additional osmotic adjustment to the cell for keeping osmotic pressure under saline conditions (Abdel Latef & Ahmad, 2015; Amagaya, Shibuya, Nishiyama, Kato, & Kanayama, 2020; Djanaguiraman & Varas Prasad, 2013; Haseeb, Nawaz, Rao, Ali, & Malik, 2020; Nooren, Siddiq, Hussain, Ahmad, & Hasanuzzaman, 2017). The class of cation/proton antiporter1 (CPA1) is a transmembranes antiporters which adds to cations the Na⁺ or K⁺ particle transmembrane operate for proton (H⁺) utilizing electrochemical slopes created by various translocating chemicals, for example, proton ATPase in the cell membrane or plasma layer, phosphatase and vacuolar ATPase in intracellular compartments of cells (Bölter, Mitterreiter, Schwenkert, Finkemeier, & Kunz, 2020; Horie, Karahara, & Katsuha, 2012; Morgan, Platt, Lloyd-Evans, & Galione, 2011; Rodriguez-Rosales et al., 2009). It has been found that the first most K⁺/Na⁺ proton (H⁺) cation antiporter was identified as AtNHX1 in Arabidopsis thaliana which has also been cloned (Hasegawa, Bressan, Zhu, & Bohnert, 2000). These ATPase, phosphatases, and vacuolar ATPase are available in cells, for example, microorganisms, plants, organisms, and creature cells. Every single eukaryotic genome which has been sequenced up to now has shown a large number of isoforms of these antiporters, except for yeast (Brett, Donowitz, & Rao, 2005; Ismail, Riemann, & Nick, 2012).

The cation/H⁺ antiporter1 plant qualities were doled out to either the Na⁺/H⁺ exchanger (NHX) or Na⁺/H⁺ (NhaP) clade (Chanroj et al., 2012; Pardo, Cubero, Leidi, & Quintero, 2006; Wang, Wu, Liu, & Qiu, 2015). Qualities doled out to the previous clade encode proteins that are situated in the plasma layer and are like the NHE-1 protein or human sodium hydrogen exchanger isoform-1 proteins (Chanroj et al., 2012; Mahajan & Tuteja, 2005; Qiu, Guo, Dietrich, Schumaker, & Zhu, 2002) whoever; the intracellular (IC) films are situated in the NHX clade. The intracellular class I Na⁺/H⁺ exchanger or NHX1s are kept in the tonoplast of the cell which is plant-specific explicit (Brett, Donowitz, & Rao, 2005; Mahajan & Tuteja, 2005); the intracellular class IIs which may be found within cell endosomes and which are firmly connected to the ScNHX1 protein of yeast (Bowers, Levi, Patel, & Stevens, 2000; Tester & Davenport, 2003) while for human sodium protein (hydrogen) exchange proteins like NHE6 and NHE7 (Chanroj et al., 2012; Xiong, Schumaker, & Zhu, 2002). It has been found that the rice and Arabidopsis thaliana cation/proton antiporter1 are nearly the equivalents in size: which have two NhaP isoforms in Arabidopsis thaliana (NHX8 and NHX7 or salt overly sensitive1 (SOS1)) while there is one salt overly sensitive1 (SOS1) in rice. Six qualities in A speak to the NHX clad. Thaliana and rice by five: Intracellular-Is (IC-Is) OsNHX1-4 and atNHX1-4, while IC-IIs AtNHX6, OsNHX5, and atNHX5.

The Arabidopsis thaliana IC-Is and rice share 54-87 percent polypeptide likeness, while the closeness of the three IC-Is which ranged from 72-79 percent. The IC-II and IC-I successions share a likeness of just around 22 percent (Bartels & Sunkar, 2005; Modareszadeh, Bahmani, Kim, & Hwang, 2020; Zhu, 2003). Particle and pH homeostasis are basic to the activity of numerous cell forms basic plant advancement and development. CPA1 movement is the main determining factor of cell osmotic condition and accordingly of cell weight. Strain to direct vacuolar and endosomal pH and particle piece influences the handling and dealing of proteins just as the arrangement and development of vesicular payload (Bowers, Levi, Patel, & Stevens, 2000; Pardo, Cubero, Leidi, & Quintero, 2006; Vinocur & Altman, 2005). The proposal is to keep its compartment qualities. This audit centers on the physiological significance of the CPA1 plant classes (Deinlein et al., 2014; Hrabak et al., 2003; Naseem, Ali, & Malik, 2020; Rodriguez-Rosales et al., 2009; Sajid, Rashid, Ali, & Husnain, 2018).

Cation/H⁺ Antiporter1 for Salt Stress Tolerance

At the point when presented to a saline situation, plants unavoidably collect Na⁺ particles (in spite of the fact that to changing degrees), compelled by the main Na⁺ inclination among the dirt arrangement and plant’s interior. The competency to limit the retaining of Na⁺ in the roots is an essential
The loss of saltiness stretch instigated biomass (Li et al., 2017; Pehlivan et al., 2016). Interestingly, both tomato plant needs NHX2 (IC-II NHX) and NHX1 while Arabidopsis thaliana plant NHX2. The twofold freak Arabidopsis thaliana nhx5nhx6 is extremely sensitive to saltiness (Baghour et al., 2019; Jia et al., 2018; Jiang et al., 2017; Yousef, Shafique, Ali, & Malik, 2020; Zhou et al., 2018). V-ATPase vacuolar deficient plants have decreased nitrate stockpiling limit and don’t over accumulate Zn$^{2+}$ and are not excessively delicate to saltiness.

Plants with expanded endosomal or trans-Golgi arrange (TGN) movement restricted V-ATPase, then again, are delicate to saltiness (Deinlein et al., 2014; Hedrich, 2012; Krebs et al., 2010). The suggestion is that the endosomal/vesicles framework gives a critical method for shielding plants from the harm caused by saltiness worry, as different examinations have upheld (Abogadallah, 2010; Ma & Bohnert, 2007; Mazel, Leshem, Tiwari, & Levine, 2004). The saltiness resilience of NHX over-communicating plant gives off an impression of being autonomous of both the cause of transgene species and character of encoded isoform: IC-II and IC-I anti-porters seem to having a comparative job in resistance of saltiness. Since NHX transporters likewise convey K$^+$ particles, they are relied upon to influence intercellular K$^+$ content, especially on account of IC-II antiporters explicit to K$^+$. The overexpression of either AtNHX1 or AtNHX2 has appeared together K$^+$ and Na$^+$ content in ENA is expanded (principle arrangement of Na$^+$ efflux) and ScNHX1-disturbed yeast cell developed in NaCl (Mäser et al., 2001; Steiner & Sazanov, 2020; Quintero, Blatt, & Pardo, 2000; Yokoi et al., 2002).

The derivation is that CPA1-intervened ScNHX1 and ScNHX5 encoding the IC-II anti-porter increment K$^+$’s cell content, however, decrease Na$^+$’s content binding locales associated with K$^+$ take-up (Quintero, Ohta, Shi, Zhu, & Pardo, 2002; Rus et al., 2001). The Na$^+$ expulsion from cytoplasm accomplished via SOS1 in this way shield cells from the loss of the layer transport limit of K$^+$. This applies particularly to the K$^+$ channel AKT1 (Arabidopsis K$^+$ transporter1) (Qiu et al., 2004; Serrano & Rodriguez-Navarro, 2001).

**Cation/H$^+$ Antiporter1 for Homeostasis of K$^+$ in Cells**

The derivation is that the CPA1-intervened saltiness resilience of the plant isn’t only a result of the aggregation of the Na$^+$ inside of vacuoles and...
expulsion of Na⁺ from the cell; be that as it may, at any rate, some portion of this resistance mirrors the impact of CPA1 on the cytoplasmic substance of K⁺. Some CPA1s, especially NHXs, was recommended to take an interest in K⁺ homeostasis under ordinary states of development (Olias et al., 2009). Other than being a basic supplement, the K⁺ adjusts intracellular load and is additionally a co-factor in certain cytosolic chemicals. Most of the K⁺ cell is found in the vacuole, where it keeps up weight and hence in a roundabout way drives cell extension (Leidi et al., 2010). Cytoplasmic ferritin can be utilized as a flag to actuate either high liking K⁺ soil ingestion or K⁺ vacuole efflux (Chauhan et al., 2000; Venema, Belver, Marín-Manzano, Rodríguez-Rosales, & Donaire, 2003). The decrease in the pH inclination over the tonoplast film might lessen the collection of vacuolar K⁺ compelled by IC-I NHX1. The statement of NHX1s in grapes was altogether up-regulated for the ripening of grapes and the cell extension, with the aggregation of grapes K⁺ in vacuoles and descent in acidity (Aharon, Apse, Duan, Hua, & Blumwald, 2003; Gao, Ren, Zhao, & Zhang, 2003). There is a decrease in anti-port movement in Arabidopsis thaliana NHX1 invalid freaks that shape littler cells and demonstrate a diminished development of exceedingly vacuolated cells; these impacts might be identified with K⁺ vacuum shortage required to guarantee cell extension weight potential (Dhar, Sägesser, Weikert, Yuan, & Wagner, 2011; Jiang, Leidi, & Pardo, 2010). Micro-array based transcriptomic investigation demonstrated that qualities encoding great proclivity K⁺ take-up transporters are uncontrolled without a practical NHX1 duplicate, which underpins the possibility that AtNHX1 is associated with K⁺ homeostasis (Janz et al., 2010; Shabala & Munns, 2012).

Although, when the firmly related NHX2 isofrom is thumped out, no reasonable phenotype is actuated. Twofold nhx1nhx2 freak fundamentally decreases cell development and development, especially in the quickly extending fiber (Ohnishi et al., 2005; Pardo & Rubio, 2011). The vacuolar K⁺ + Double freak component is just a single third in the wild plants, both in the leaf and in the root (Baghour et al., 2019; Deinlein et al., 2014). The opening of stomata relies upon expansion in K⁺ vacuum cell contents: a procedure is dependent on NHX vacuum (An et al., 2007; Fukuda et al., 2004). These perceptions underscore the significance of vacuolar NHX for the K⁺ homeostasis of cells. NHX knockdown/knockout prompts genuine development deserts. In tomatoes, for instance, the crumble of LeNHX2 causes development delays (Chauhan et al., 2000; Jiang, Leidi, & Pardo, 2010), and likewise in Arabidopsis thaliana, NHX5 and NHX6 misfortunes all the while decrease cell estimate and moderate both botanical advancement and root development (Qiu et al., 2004). The K⁺ substance of the twofold freak nhx5nhx6 is fundamentally lower than that of wild tissue (Padmanaban et al., 2007; Wang, Wu, Liu, & Qiu, 2015; Yamaguchi & Blumwald, 2005). The constituent appearance of NHX6 and NHX5 in the two freaks safeguards the development of the root. Endosomal NHXs hence contribute generously to development and extension, possibly by means of their subsidizing of K⁺ homeostasis. Though, the inadequacy of coordinated K⁺ positive microprobe obliges the degree of K⁺ placated in vesicles, keeping away from the identity of a piece of endosomal-vesicular NHXs in K⁺ homeostasis (Ohta et al., 2002; Rajagopal et al., 2007).

**Cation/H⁺ Antiporter1 for Homeostasis of pH in Cell**

For all types of cell functions, cell pH homeostasis is an extremely basic component for normal cell functioning and regulation. The pH of the cytoplasm is well-ordered essential by proton siphons and metabolic procedures delivering hydroxyl or protons particles. Luminal pH isn’t constant all throughout the cell; it is also in focus on the intracellular compartments of cells (Paroutis, Touret, & Grinstein, 2004; Shen et al., 2013). In-vivo estimation uncovered that the pH varies from 7.1 within the endoplasmic reticulum to almost 5.5 pH in the vacuoles; the trans-Golgi network is extra acidic than the pre-vacuolar compartment that is the middle of the cell transporting organelles wherever secretory and endocytic traffic prompts the vacuoles (Bassil & Blumwald, 2014; Orij, Brul, & Smits, 2011). Certain the inclusion of CPA1s in proton spillage, it’s not really astounding that they can manage pH in the vesicle or in the cytoplasm relying upon their sub-cell confinement. Proof for intra-cellular NHX-subordinate pH direction previously emerged from an investigation of pigmentation of Ipomea sp. petals (Martiníère et al., 2013; Yoshida et al., 2005; Zhao, Barkla, Marshall, Pittman, & Hirschi, 2008).

Along with improvement, petal starts to gather the anthocyanins in the cell vacuoles: these outcomes in red shading at lesser vacuolar blue
shading as pH increase. The expansion of petal vacuolar pH which ranged from 6.5-7.5 is joined by an enhanced proton-PPase, NHX1, and V-ATPase action. Coordinate vacuolar pH estimations in NHX freaks emphatically show that vacuolar NHX antiporters are vital in vacuolar pH direction. Twofold freak thaliana nhx1nhx2, the vacuolar condition is fundamentally a greater amount of acidic than in the wild type cells of stretching and development zone, particularly in the cortical or surface cells of leaves and roots (Hamaji et al., 2009; Pittman, 2012). Root tip cells will in general have more corrosive pH than develop cells of the root zone. There is, nonetheless, little distinction between nhx1nhx2 cell pH and wild plants in root tip cells (Li, Li, Li, & Wu, 2011; Reguera, Bassil, & Blumwald, 2014). The result is that NHX anti-porter action is increasingly articulated in cells that essential to expand their vacuum volume so as to lengthen them. To gauge luminal pH in the Golgi locale body, trans-Golgi network, and late pre-vacuolar compartment. Luorin based pH sensors were utilized (Reguera, Bassil, & Blumwald, 2014; Senadheera, Singh, & Maathuis, 2009; Tester & Davenport, 2003); their outcomes are that pH in such compartment is lower than in wild sort in the nhx5nhx6 twofold freak, which suggests that vesicular/endosomal NHX1s increased the vesicle pH of cell. Wang and his colleagues exhibited that the nhx5nhx6 showed a lower vacuolar pH as estimated by the half electrical microelectrode (Wang, Wu, Liu, & Qiu, 2015). Despite the fact that the contribution of NHX plant transporters in cytoplasmic pH control still can’t seem to be illustrated, utilization of fluorescent examples demonstrated that passing of a practical duplicate of AtSOS1 consequences in adjusted pH homeostasis in both root and stem cells, most likely because of a change in proton transition over the plasma layer (Ahmadi, Corso, Weber, Verbruggen, & Clemens, 2018; Manohar, Shigaki, & Hirschi, 2011; Mei et al., 2009).

**Plant Cation/H+ Antiporter1 (CPA1s)**

As of late found usefulness of the endosome localized proteins, AtNHX6 and AtNHX5 are principally entrancing. Much same as the yeast cells (Baghour et al., 2019; Chauhan et al., 2000; Li, Li, Li, & Wu, 2011) and animal cells (Casey, Grinstein, & Orlowski, 2010; Kruwilch, Sachs, & Padan, 2011), quality difference nhx5nhx6 twofold freak articulation is to a great extent identified with vesicular and vacuole transport system (Cao et al., 2016). Endocytotic tracer lipophilic stylryl color (FM4-64), and checking the dynamic fluorescence naming of endo-membranes has been appeared to have been extremely deferred in nhx5nhx6 naming of the vacuole. Likewise, recently blended carboxypeptidase Y-green fluorescent protein (CPY-GFP) dealing, that regularly aggregates in the vacuole, transported towards the apoplast in the nhx5nhx6 containing plants (Adams & Shin, 2014; Kumar, Kumar, Kim, Ryu, & Cho, 2013). A practical connection among based on broad co-area of TGN-restricted, the VATPase complex, NHX6 and NHX5 have also been studied (Joshi, Jha, Mishra, & Jha, 2013; Reguera, Bassil, & Blumwald, 2014). The proposition is that endosomal NHXs control vesicular dealing through their endosomal particle direction and pH homeostasis. In any case, pH isn’t the main maintainer of the endosomal catalyst action and protein security, since it additionally adds to the identity of the vesicle, direction of receptor and freight communications, and, at last, endomembrane dealing (Huertas et al., 2013; Reddy, Kim, Yoon, Kim, & Kwon, 2017). The in-vivo estimations of the vesicular pH standing of the endo-membrane compartment and their commitment to the control of the development of proteins should set up the biochemical reason for these procedures.

In the endoplasmic reticulum, the seed storage proteins which are incorporated as forerunners and transported into protein stockpiling vacuoles are also involved to develop organelles of the cell. Many findings have demonstrated that proteins transported to the vacuole via a vesicle-interceded dealing course that incorporates pre-vacuolar compartment endoplasmic reticulum, trans-Golgi network, Golgi, and multi-cycle bodies. Along these lines, the trans-Golgi network, Golgi and multi-cycle bodies, pre-vacuolar compartment are major vesicular protein arranging stations (Almeida, Margarida Oliveira, & Saibo, 2017; Qiu et al., 2004). In the protein dealing pathway, AtNHX6 and AtNHX5 are limited to the trans-Golgi network, Golgi, and the pre-vacuolar compartment. IC-I anti-porters may likewise take part in intracellular vesicle dealing, as an NHX1 T-DNA inclusion freak changes the translation of an extensive amount of qualities encoding a protein-related with intra-vesicular dealing, core dealing, and preparing in the Golgi, and the pre-vacuolar compartment. IC-I anti-porters may likewise take part in intracellular vesicle dealing, as an NHX1 T-DNA inclusion freak changes the translation of an extensive amount of qualities encoding a protein-related with intra-vesicular dealing, core dealing, and preparing in the Golgi, and the pre-vacuolar compartment.
fundamental focal point of CPA1 articulation has been on saltiness worry, for instance, the salt-initiated AtCAPE1 contrarily controlled salt resistance by smothering a few salt-resilience qualities that work in osmolyte generation, detoxification, and control of stomatic conclusion and protection of the phone layer. Intravascular control assumes an essential job in the cell extension and blossom advancement of AtNHX1 and AtNHX2 K⁺ substance and pH (McCubbin, Bassil, Zhang, & Blumwald, 2014; Shin, 2014; Wang et al., 2016). In any case, a few individuals from this quality family give off an impression of being inducible by abscisic acid (Wu, Ebine, Ueda, & Qiu, 2016; Yokoi et al., 2002), KCl (Fukuda et al., 2004), drying out (Li, Li, & Wu, 2011) as well as hyper-osmotic pressure (Yokoi et al., 2002). Disconnection of definite NHX qualities from Morus atropurpurea has as of late exhibited that they are inducible by saltiness, dry season, and abscisic acid, as well as by salicylic acid, methyl jasomate, and hydrogen peroxide (Cai et al., 2016; Ma, Augé, Dong, & Cheng, 2017; Wu et al., 2016).

Cation/ H⁺ Antiporters and Regulation of Cell Structures

It has been identified that the Na⁺/H⁺ antiporters played an important role in the regulation of cellular Na⁺, Ca⁺, K⁺, pH, and cell homeostasis under environmental conditions. The genetic studies of NHX1 and NHX2 have shown that under double knocked out of NHX1 and NHX2 caused a reduction in the plant growth under stress environment (Bassil et al., 2011; Chanroj et al., 2012; Hanin, Ebine, Ueda, & Qiu, 2016). It also caused a reduction of cell size, short hypocotyls, the abnormal stamens produced in the flowers. The NHX1 and NHX2 caused reduced growth of pollen tubes which caused hindrance in pollination, while the pollen viability and germination were not affected even under stress conditions. The NHX1 and NHX2 play important role in the development of flower and cell expansion under stress conditions (Almeida, Margarida Oliveira, & Sálio, 2017; Assaha, Ueda, Saneoka, Al-Yahyai, & Yaish, 2017; Ismail & Horie, 2017; Yang & Guo, 2018). The salt stress caused damage in the roots and shoot of maize seedlings, the production of osmolytes in the roots and shoots of seedling lead towards the repairing of damage. The use of yeast and carrot extracts help to maintain the concentrations of K⁺, Na⁺, and Ca²⁺ in the cells to regulate the antioxidant enzymes and cation/H⁺ antiporters which also help to maintain the cell membrane, and membrane-bounded organelles of cells under stress environment (Abdel Latef, Mostofa, Rahman, Abdel-Farid, & Tran, 2019; Jiang et al., 2019; Ye, Zhao, Bao, Cao, & Zou, 2019). The reduction in photosynthesis was reported in watermelon under salinity and alkalinity stress conductions due to the damage of chloroplast cells, the destruction in the thylakoid membranes under the formation of reactive oxygen species. The production of cation/H⁺ antiporters helps to maintain the ion concentration in the matrix and within the membrane-bounded organelles. There is also the release of osmolytes in the cytosol to prevent damage or cell structures (Amao & Hernández-Ruiz, 2019; Jiang et al., 2019; Tian et al., 2019; Ye, Zhao, Bao, Cao, & Zou, 2019). Hereditary studies give convincing proof that the three classes of CPA1 (cell membrane or plasma membrane, vacuolar and endosomal) control an assortment of cell and physiological procedures, containing cell extension, cation homeostasis, and osmotic procedures (Tian et al., 2019; Yang & Guo, 2018). Also, it involved the potential for weight, pH homeostasis, and dealing with vesicles, stomata capacity, and flower advancement (Bafeel, 2014; Bassil et al., 2011).

CONCLUSION

The accessibility of numerous CPA1 knockout lines and the improvement of stages equipped for estimating in vivo pH and particle contents in many intracellular compartments have made it conceivable deeper comprehension or understanding of the protein potentials and ability to function in cells. To illuminate the hidden instruments, the distinguishing proof of the protein accomplices that direct the exercises of these bearers is important. In light of the worry of saltiness, the three CPA1 classes seem to cooperate. They are additionally vital for keeping up pH and K⁺ cell content. They coordinate in managing an assortment of procedures from bladder dealing and cell extension to plant development.

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