Introduction

Oxytocin means quick birth; a word which is derived from Greek. It is a peptide hormone synthesized in magnocellular-neuro-secretory-cells in supraoptic and para ventricular hypothalamic nuclei while stored in posterior pituitary lobe then released in the blood as a result of a neuroendocrine reflex. OT is packaged in granules, then transported-down with posterior- pituitary-gland-axon and excreted to the systemic circulation with carrier protein, the neurophysins. It is related to the reproductive
OT Applications

In all the mammals OT is secreted endogenously for induction and maintenance of labor at birth process and for milk letdown in lactation. It causes uterine contraction as well as milk-ejection through promotion of myoepithelial-cell’s contraction which surrounds milk alveolus. Natural OT causes milk to be ejected from the breasts during lactation: the amount of OT produced naturally, however, does not stimulate labor. For induction of labor at birth there is a need for administration of exogenous oxytocin. In order to duplicate the hormone and create an artificial drug OT (Syntocinon) was developed in 1953 by Vincent du Vigneaud (Bruckmaier, 2003). In case of the non-progression of parturition, generic oxytocin analogues (synthetic OT) are used to facilitate the birth by induction and support of labor. It is very important physiologically for cervical dilation before the birth and contractions in 2nd and 3rd stage of labor during delivery process.

The half-life of the OT in blood is 0.55 to 3.6 minutes, so it rapidly disappears from blood stream through the action of various enzymes only within 2–6 minutes (Ijaz and Aleem, 2006). OT causes contractions of the smaller ducts and myoepithelial-cells around the alveoli of mammary gland. After discovery of OT and studying it’s role in neuro-hormonal-milk-ejection process, it was recognized as a pharmacologic agent to facilitate and allowed the managing of milking-process with an exogenous-OT administration; Thus it ↑ the yield of milk in dairy animals (Kiran, 2001).

Effects on milk production

OT administration to cattle for whole lactation resulted in ↑ milk yield by 11.6% over control animals (Nostrand et al., 1991). Similarly, milk production ↑ (P<0.05) through the use of oxytocin treatments (Bencini et al., 1992). Ballou et al. (1993) found that OT increased (P<0.05) milk production by 3% before and after milking which is increased gland milk output rather than residual milk removal. It is obvious that total evacuation of the udder during milking so that there is no-residual milk reduced production-losses which occur when using once a day milking, while ↑ the rate of milking was found ineffective in reduction of losses (Carruthers et al., 1993). Bruckmaier et al. (1994) noted that in goats prestimulation of the mammary gland caused the release of sufficient OT to release the large volume of cisternal milk present without causing the characteristic bimodal pattern of milk flow. Moreover milk-ejection in ewes also occurred in response to higher OT concentration (Bruckmaier et al., 1994).
in southern Punjab, the author observed that mostly people and rural development by livestock extension education. While working on a project about poverty alleviation, there was a significant increase in milk yield over the control group. Milking on milk yield in Nili-Ravi buffalo and found a difference in milk yield between OT-injected cows and control cows, respectively (8.7±0.8: 3.2±0.8 kg).

Akhtar et al. (1995) investigated the effects of OT administration before milking on SCC and fat content in milk of Nili-Ravi buffalo and found that SCC was increased by OT injection whereas there was no effect on milk-fat %.

Effects on milk composition

OT administration does not affect the percentages of milk fat, lactose, protein, somatic-cell counts (SCC) or milk plasmin activity (Nostrand et al., 1991; Bencini et al., 1992). Ballou et al. (1993) reported that the effects of OT are not manifested through changes in cell remodeling. In contrast to that, there was significant decrease in percent acidity, protein, fat, solids-not-fat (SNF) and total-solids of OT injected milk in buffaloes as reported by Kiran (2001). This response may be due to variations in diet, season, the timing and dose of exogenous OT injections. On the other hand, Indian scientists Sing and Aggarwal (2001) studied the mineral composition in milk of Murrah buffaloes as affected by exogenous OT administration and found that Cu, Mg, Zn, Fe and Mn secretion is influenced by OT administration as increasing Cu and Mn contents while decreasing Mg, Fe and Zn contents; however, Ca secretion is not affected. In another study Lollivier et al. (2005) determined that fat and protein were positively correlated; when one decreased the other one also decreased with, SNF and total solids contents following the same pattern.

In Pakistan increases in Na, Cl, Cu and ash contents and decreases in lactose and K contents were observed in OT administered Sahiwal cows (Hameed et al., 2010). While Akhtar et al. (2012) investigated the effects of OT administration before milking on SCC and fat content in milk of Nili-Ravi buffalo and found that SCC was increased by OT injection whereas there was no effect on milk-fat %.

Effects on reproductive health

The use of exogenous OT at milking increased lactation milk yield with no apparent effect on reproductive health (Nostrand et al., 1991). Milk letdown without administration of OT seems to be difficult in the animals which regularly exposed to OT injections as they become habitual to the drug. While repeated administration of OT injections therefore interferes with the normal
mammary epithelium milk secretary activity thus inhibits the normal milk ejection process and affect reproductive health (Mustafa et al., 2008).

It is believed that the prolonged use of OT injections also causes fertility disorders like poor estrus signs, reduced lactation period, lower conception rate and high embryonic mortalities in the local herds of cattle and buffalo (Siddiqui and Saeed, 2000). Delayed puberty, lower conception rates, increased abortion rates, lower pregnancy chances, delays in the duration of placenta expulsion, ovulation interval, shortened postpartum estrus interval and calf death soon after the delivery because of poor quantity and quality of milk have also been observed (McDonald, 1989; Bhullar et al., 1991; Dominguez et al., 1993; Weiss et al., 2002; Dzidic et al., 2004; Mustafa et al., 2008; Qureshi et al., 2008). Further complications have been observed with OT treatment including delayed age at puberty, dystocia (difficult birth, abortions, dead fetus, retention of placental membranes, lower milk fat percentage and decreased milk production in buffalo and cows (Shaw, 1942; Hassan, 1993; Murugaiyal et al., 2001; Weiss et al., 2003; Thomas et al., 2004; Ariota et al., 2007; Bidarimath and Aggarwal, 2007; Qureshi et al., 2008).

Reproductive anomalies such as ovarian follicular cysts, corpusluteum cysts, placental retention, anestrous and the repeated estrus cycles in cattle and buffalo have also been reported (Cameron and Fosgate, 1964; Labhsatwar et al., 1964; Booth and McDonald, 1982; Peters and Laven, 1996; Tiwari et al., 1999; Mavi et al., 2004; Drillich et al., 2006, 2007). OT affects the cell maintenance and mammary metabolism in addition to its well-established physiological role in the milk-ejection reflex (Zamiri et al., 2001). There seems to be no harm in humans consuming the milk from OT treated animals. However, its usage in the pregnant dairy animals should be discouraged (Ijaz and Aleem, 2006). Iqbal et al. (2013) studied OT induced oxidative stress in lactating Nili Ravi buffaloes and reported that OT injection resulted in an ↑ oxidative stress by increased ceruloplasmin and total homocysteine oxidase activity and ↓ the enzymatic activities of antioxidant enzymes including arylerase and paraoxonase-1. Their changes are very likely to reduce the reproductive and productive performance of buffalo.

OT administration directly affects the bovine reproductive system thus reducing the life expectancy of animal as reported from India (Naidu, 2013). Moreover, Gupta (2014) reported on the use of OT in the dairy industry, suggesting that its uncontrolled use for milk let-down should be illegal. His conclusion was based on the hormonal imbalance and harm to the reproductive system of treated animals, thus reducing their lifespan. A similar conclusion was drawn by G.N. Singh after studying its use on small-holder dairy farms in India (Sharma, 2015). Anjali Aggarwal reported the perception that OT injections for milk let-down in pregnant animals may cause abortion is incorrect, as OT receptors remain absent throughout gestation and appear only towards the end of pregnancy. She also added that OT has a short life span of about 2-2.5 minutes so that side effects on animal health are likely to be minimal. In some report, Srivastava stated that lack of response to normal stimuli for milk ejection and addiction in animals are the main disadvantages of continuous usage of OT injections (Arora, 2016). In Pakistan, working on a project “Setting-up livestock farmer’s data base in Southern Punjab”, Faraz and Waheed (2020) observed that people mainly use OT for milk letdown in their animals and they reported that by using OT injections, the animals may get problems of abortion, mastitis and metritis (Personal Communication).

In Pakistan, the use of exogenous OT extensively for milk letdown is widespread on small-holder dairy operations. No doubt it is a malpractice that definitely disrupts the normal natural milk ejection process and has an adverse effect on reproductive health in dairy animals. Milk quality is also affected by OT administration in dairy animals. Farmers commonly use this hormone for milk letdown as it is easily available at retail shops in our country. The dose used by farmers are not regulated and so the use of this drug is based on the farmer’s own experience without any knowledge of the side-effects of the drug on reproductive health and milk quality. Clearly the education of farmers on OT use is lacking in this area across Pakistan.

Residual effects

Ballou et al. (1993) reported that the effects of oxytocin administration are not manifested through effects on cell remodeling. It is a peptide hormone which is synthesized in hypothalamic neurons and then released from posterior pituitary lobe. OT produces its desired effects in minutes and then is readily metabolized in inactive products. It is mostly secreted and ingested along with the milk, it is efficiently degraded by gut enzymes so can’t reach the blood circulation in biologically active form (Ijaz and Aleem, 2006).

Pullakhandam et al. (2014) determined that oxytocin injection in milking buffaloes do not influence the content of OT in milk. OT that is found in milk, is rapidly degraded during intestinal digestion, and so is not absorbed intact to pass via the circulation to accumulate in milk or meat: thus, there are no harmful side effects for humans consuming these products. (Meyerhoffs, 2016). However, in another study from India, consumption of milk from OT injected animals can cause hormone imbalances in some humans leading to health problems (Naidu, 2013).
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Conclusions

The benefits and safety dosage for OT administration at different concentrations in dairy animals is not thoroughly understood yet. It is obvious that OT does have significant effects on milk composition and also affects the reproductive health of animals. However, there seems to be no effects on consumption of milk sourced from OT treated animals. Its indiscriminate use for milk letdown should be discouraged and awareness among farmers should be created. This education process is necessary, so that the dairy industry of Pakistan can flourish and produce milk of a high enough quality to meet international standards and to compete successfully in the world export marketplace.

Conflict of interest

The authors have declared no conflict of interest.

References


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