EMERGENCE OF PEPTIDES AS POTENTIAL DRUG CANDIDATES IN NEOPLASMS

Abstract

For the therapeutic intervention and medical management of cancer, numerous distinct treatment strategies have been explored. Chemotherapeutic drugs used clinically are having narrow therapeutic profile with harmful side effects and the subsequent multiorgan toxicity. Therefore, recent research has focused on uncovering the best alternative for a cancer with minimal negative outcomes as well as with greater efficacy. Among various nutrients, peptides are found with highest potency and minimal adverse effects. Anticancer Peptides (ACPs) are peptides that can be witnessed in both natural and synthesised forms, and their distinct net charge and structure render them to show specificity towards malignant cells. This review encompasses peptides from a wide range of natural biological sources, including marine, animal, plant, insect, wasp, frog, snake venom and dietary sources. Several *in vitro* and *in vivo* research findings of those peptides are highlighted along with the underlying potential mechanism of action.

Key words: Peptides, malignant cells, Anticancer peptides

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I. INTRODUCTION

Cancer as the most prevalent catastrophic illness, is primarily imposed by defects in cell division, which can be manipulated by environmental, genetic, and chemical factors. It is characterized by the incontinent proliferation of cells which leads to progression of illness from benign stage to malignant type. Several curative approaches such as immunotherapy, chemotherapy, radiotherapy and surgical removal of tumour have been focussed on the warfare against cancer (Xi *et al.,* 2020). Immunotherapy alludes either the modulation or usage of components of host immunity in the therapy of cancer. Non-specific inflammatory stimulants such as bacterial lipopolysaccharides, tumour related antigens, cytokines, and antibodies are some of the constituents that trigger, activate and strengthen the immune system. (Dillman, 2011). For the medical management of localised solid tumours, radiotherapy is the most efficacious cytotoxic treatment. The four 'R's of radiotherapy include repair, redistribution/reassortment, repopulation and reoxygenation. Several chemotherapeutic medicines administered in tandem with radiation therapy usually address the mechanism of DNA repair process (Schaue and McBride, 2015). Endocrine targeted hormonal based therapeutic approaches have also been done for the neoplasms involved in breast and prostate as they are mostly connected with hormonal imbalances. Hormone therapy for cancer treatment should be used with caution because some hormone equivalents can provoke profound reproductive malfunctions and declined ovarian activity. A specific wavelength of light is employed in photodynamic therapy to trigger photosensitizing drugs like photofrin and foscan, which inflict crucial photodamage to tumour cells. As they target only specific superficial regions of the body, deep seated areas can't be treated. It had been found that combination of peptide-based drugs and other conventional treatment interventions yielded better inference than the single mode of treatment (Hwang *et al.,* 2022).

Metabolites of plant based dietary compounds which are taken by humans in their meals are stuffed with plenty of pharmacological curative properties, hence they are popularly known as nutraceuticals (Ullah *et al.,* 2016). The onset and emergence of human carcinogenesis can be stretched with chemoprevention involving dietary elements, which would turn in a higher standard of life (Sporn and Suh, 2002). Alternative compounds, such as peptides and their analogues, have been extensively explored in research investigations centred on discovering anti-cancer agents (Jamadi *et al.,* 2017). Currently, the clinical application of peptides as healing agents has been rising in both natural and synthetic form. This review indisputably illustrates that peptides from different sources have the prospective to serve as beneficial adjuvants for the treatment of cancer in a wide array of modalities.

II. ANTICANCER PEPTIDES

When juxtaposed with traditional chemotherapy, peptide-based focused cancer therapy delivers a high degree of specificity with minimal unintended effects. Recently, the adoption of peptides either in its natural or commercially developed form have been upsurging due to their curative properties. The interaction between cancer cells and peptides are due to their electrostatic interactions whereas in normal cells it is mostly hydrophobic interactions (Li *et al.,* 2014). Anti-cancer peptides (ACPs) possess greater selectivity, deeper penetration with higher manipulation possibilities than antibodies and small compounds, which renders them an ideal pharmacological candidate (Chiangjong *et al.,* 2020). Peptides aimed at cancer cells often contain glycine and arginine as amino acid residues. Presence of

guanidium group in the side chain of arginine amino acid enhances the peptide capability to permeate the lipid layered membrane. It interacts with phosphate groups in the phospholipids of membrane and forms hydrogen bond which will disrupt further through pore formation. According to research findings it has been revealed that oligomerization amplifies the anticancer efficacy of dimeric and tetrameric peptides because they have a greater cytotoxic effect on cancer cells (Trinidad-Calderon *et al.,* 2021).

1. **Classification of Anticancer Peptides:** Anticancer peptides can be broadly categorised into four different classes as (a) alpha helix (b) beta sheets (c) extended structures (d) cyclic loops with its examples are mentioned in the Table 1 (Zhang *et al.,* 2023).

Table 1

Sl. No.	Type	Examples
1.	Alpha helices	Bovine myeloid antimicrobial peptide (BMAP), melittin, cecropin and magainin
2.	Beta sheets	α and β defensin
3.	Extended structures	Extended with arginine, proline,tryptophan and glycine
4.	Cyclic loops	Diffusa cyclotide

The other peculiar characteristic of α helical ACPs is their hydrophobic nature along with its positive charge. ACPs usually encompass nearly 30% hydrophobic residues, which affords these molecules a helical mould with polar and nonpolar surfaces in hydrophobic surroundings. ACPs with greater hydrophobicity on the non-polar face have enhanced helical configuration and thereby it passes more intensively into hydrophobic part of the cell membrane. This could optimise the probability of formation of pore or channel like architecture in the cell membrane (Zhang *et al.,* 2023).

2. **Normal vs Malignant Cells towards ACPs:** In contradiction with typical eukaryotic cells, the outermost packets of cancer cells are overwhelmingly made up of negatively arched lipid rafts, like phosphatidylserine (PtdSer) and phosphatidylethanolamine (PtdEth), sulfated proteoglycans, and mucin-type O-glycans. This anionic lipid rafts primarily trigger the plasma membrane of cancer cells as stunning targets for the cationiated ACPs (Behzadi *et al.,* 2020). Fluidity and permeability of the normal eukaryotic cell membrane is usually governed and modulated by the macromolecule termed as cholesterol. Hence, high proportion of cholesterol serves as a protective barrier in the entry and exit of ACPs in healthy cells. On the flip side, cancerous cells have increased fluidity due to considerably lower level of cholesterol and it make them more prone to ACPs (Sok *et al.,* 1999; Zhang *et al.,* 2023). Surface area of the cancer cells are comparatively more than normal cells due to greater number of microvilli. This will further facilitate the binding and interaction of cancer cells with ACPs. In addition, ACPs target on cancerous cells is because of its high membrane potential whereas normal cells have less membrane potential (Gajski and Garaj Vrhovac, 2013). Specificity of ACPs toward malignant cells and the underlying variations are mentioned in Table 2.

Table 2: Difference between normal healthy and malignant cells

Cellular architecture	Normal cells	Malignant cells
Lipid rafts	Comparatively less	Rich in phosphatidyl serine and proteoglycans
Fluidity	Less	More due to low cholesterol
Surface area	Less	Higher due to microvilli
Membrane potential	Low	High

3. **Cyclotides :** Cyclotides are cyclic peptides of plant origin which vary in length from 28 to 37 amino acids. From head to tail, they have cyclized backbone with three disulfide linkages (Mehta *et al.,* 2020). Its striking proteolytic, thermal and chemical stability is due to the lack of both termini and the presence of knotted disulfide framework in cyclic form (Colgrave and Craik, 2004). The development of cyclotide based drugs has been sped up due to its stable nature and are expected to address the constraints imposed by linear peptide therapy. Presence of negatively charged phosphatidyl serine residue in the cancerous cells facilitate their binding with positive charged cyclotide and subsequently, integrity of the cancer cells is disrupted (Liu *et al.,* 2011). Cycloviolacin, a protein made up of 30 amino acids with cyclic structure as their backbone. It had demonstrated cytotoxic activity against various lymphoma tumour cell lines. Cyclotide extracted from *Hedyotis diffusa,* a Chinese herbal plant has displayed cytotoxic activity against three prostate cancer cell lines with their IC50 value below 10μM (Hu *et al.,* 2015).

4. **Depsipeptides:** A peptide in which one or more of its amino groups are replaced by ester groups is referred to as depsipeptide. These peptides have been derived from a wide range of aquatic organisms, including bryozoans, sea slugs, sponges, tunicates, soft coral reefs, marine hares, and nudibranchs (O Mustafa, 2021). Argyrin A, a cyclic peptide in myxobacterium *Archangium gephyr* disables the proteasome, initiates apoptosis by means of a p27-dependent mechanism and prohibits angiogenesis. Dolastatin, a peptide from mollusc *Dolabella auricularia* had altered arrangement of actin and limited cytokinesis (Bai *et al.,* 2001).

5. **Marine Derived Peptides:** Marine plants and animals hold an approximate of 14,000 pharmacologically potent substances, which alludes to the environment's massive richness and complexity. Hence, the marine ecosystem is an invaluable repository for discovering distinct lead molecules for the generation of drugs to tackle cancer (Janakiram *et al.,* 2015). Oyster proteins from dietary agents are likely to feature an abundance of therapeutic collections, which might serve as a source for immunomodulators. Oligopeptide enriched hydrolysates developed from oyster inhibited the tumour growth substantially in a BALB/C murine model. Its antitumour activity was likely to be occurred due to the underlying activation of natural killer cells and macrophages in spleen and thymus with profound immunostimulation (Wang *et al.,* 2010).

Sea cucumbers are marine invertebrates that has appearance as cucumber with gelatinous body conformation which are prominent for their bioactive properties against several disease ailments (Janakiram *et al.,* 2015). Sea cucumber intestinal peptide (SCIP) extracted by enzymatic hydrolysation has been found to be active against MCF-7 breast

cancer cell line. SCIP was predominant in serine and glycine as their main constituent. SCIP at the concentration of 250 μg/ml greatly suppressed the activity of cells. While corresponding to the control group, culturing MCF-7 cells with various doses of SCIP for 24 h markedly diminished the expression of p-PI3k and p-AKT308 in a dose-responsive manner. Moreover, SCIP enhanced the expression of proteins such as cleaved caspase-3, bax and cleaved caspase 9 and lowered the anti-apoptotic bcl-2 protein expression (Wei *et al.,* 2021).

Scyreprocin, a peptide of cationic nature was initially found in the mud crab *Scylla paramamosain.* Recombinant form of scyreprocin (r-scyreprocin) had expressed toxic effect and inhibited the cell growth and proliferation in H460 (NSCLC) and HepG2 (Liver cancer), Du145 (prostate cancer) and T 24 bladder cancer cells but no cell damage was ascertained in normal lung fibroblasts and liver cells. Its possible mechanism was elucidated as interference in membrane integrity which was evident by the cell damage, apoptosis and release of cell contents (Yang *et al.,* 2022). Tachyplesin is a 17 amino acid composed cationic peptide present in horseshoe crab which features two anti-parallel sheets that are linked to one another by a pair of disulfide bonds to sustain its shape. It impeded the cell growth, migration and promote the apoptosis of non-small cell lung cancer cells A549 and H460 and make the resistant cells more susceptible to cisplatin (Wu *et al.,* 2021).

6. **Lunasin:** Soybean a prominent reservoir of bioactive peptides, with approximately 40% of protein is used in food industries for the manufacture of foods, feed for animals, and for the oil extraction (Meija and Ben, 2006). Lunasin is a 5.5 kDa peptide synthesised from soya bean and consists of 43 amino acid residues which is produced by the gene encoding soya albumin protein. Lunasin contains four fragments with first fragment as its role not yet known, whereas other three fragments of the peptide have therapeutic bioactive effects. In L1210 leukaemia cells, addition of lunasin enriched flour elevated the proportion of cells in the sub-G1 portion of cell cycle, which is a sign of DNA damage and deterioration in cell integrity, and it also altered the protein expression involved in mitochondrial pathway (Kaufman *et al.,* 2023). In addition, in cancerous cells it has shown epigenetic anticancer activity with its impact on the histone code and alterations in the activity of Histone acetyl transferase (HAT) and histone deacetylase (HDAC). Administration of lunasin in human melanoma cells A375 and B16-F10, showed notable anti proliferative action with IC_{50} values as 300 μM.

In vivo activity of lunasin in different murine models were studied by the injection of cancer cells such as human MDA-MB-231 (breast cancer), A375 (melanoma cells), human non-small lung cancer and mouse lung carcinoma cells. All the treated animals showed significant reduction in tumor volume compared to that of groups not treated with lunasin (Vuyyuri *et al.,* 2018). Similarly, bovine lactoferrin is the precursor of bovine lactoferricin (LfcinB) before undergo peptide hydrolysis in the stomach and contains amino acid residues from 17-41 of the N- terminus. LfcinB had shown cytotoxicity in HT-29 cells with apoptotic changes and significantly elevated the activity of caspase 8 (Jiang and Lonnerdal, 2017).

7. **Gramicidin:** Gramicidin, a linear peptide with alternate composition of 15 amino acids in L and D form with N-terminal formyl group and C- terminal ethanolamine moiety. Gramicidin at the concentration of 1 μM affected the viability of renal cell carcinoma cell line. Its mode of action was found to be similar to the conventional ionophore antibiotic, monensin due to its cation selectivity. Inhibition of oxidative phosphorylation and glycolysis sequential route resulted in ATP depletion followed by necrotic injury and cell death. Gramicidin compromises the equilibrium of Na+ and K+ ions which further limits the cellular metabolism and depletes the energy needed for the viability of cancer cells. Gramicidin induced oxidative stress in cancer cells was unveiled by the marked elevation in levels of AMP activated protein kinase (AMPK) and Nicotinamide adenine dinucleotide phosphate (NADPH) which are the hall mark indicators of cells response to oxidative stress. Furthermore, it reduced the hypoxia inducible factor (HIF) associated tumor angiogenesis as it upregulated the VHL protein expression which is necessary for the degradation of HIF (David and Rajasekaran, 2015). It has been demonstrated anti proliferative effect in human gastric cancer cell lines like SGC-7901 and BGC-823 but it had no effect on the proliferation of human gastric mucosal epithelial cells (Chen *et al.,* 2019).

8. **Frog Derived Peptides:** Magainin II is a member of a group of antimicrobial peptides that was originally reported in the skin of the *Xenopus laevis,* an African clawed frog. Presence of alpha helical configuration in magainin II permits it to adhere with the non-polar lipid component of the cell membrane. After the bonding with cell membrane, it creates ion permeable pores or pathways in the membrane which in turn will lead to cell death due to underlying depolarization and cell lysis phenomenon. It exhibited significant antitumor effect against three bladder cancer cell lines such as RT4, 647V and 486P but with no cytotoxic activity against normal bladder fibroblast cells (Lehmann *et al.,* 2006). Palmitoylation i.e. addition of fatty acids to the N-terminal portion of magainin derivative P1MK5E, boosted its capability to permeate the membrane of cancer cells. Its anticancer potential was evident by its interference in cell cycle at S phase and ROS mediated cell damage in A549 tumour cells. Early and late-stage apoptotic changes and necrosis were observed in treated cells after 48h of incubation with P1MK5E (Behzadi *et al.,* 2020).

   Dermaseptin a cationated peptide derived from skin of frog, interacts with negative charged phospholipids of cell membrane and its amphipathic nature enables it to penetrate the cell membrane. It showed cell damage at concentrations of 10^{-5} M in H157 cells, and the extent of apoptotic changes were dependent upon the varying concentrations. in vivo murine models implanted with H157 cells were showed with reduction in tumour volume (Dong *et al.,* 2020). Brevinine, a peptide isolated in the skin of oriental pond frog *Rana brevipoda porsa* composed of 24 amino acid residues. When K562 cancer cells (myelogenous leukemia) were subjected to treatment with Brevinin-2R and its two analogues, it triggered cell cycle arrest and apoptosis. Its anticancer activity was due to interference and blockade of mitochondrial function and disturbance of lysosomes in the cytoplasm (Jamadi *et al.,* 2019).

9. **Insect Derived Peptides:** Cecropin, an insect derived peptide which contains 34-39 amino acid residues. The giant silk moth *Hyalophora cecropia* haemolymph furnished the first source of the antimicrobial peptides Cecropin A and Cecropin B that constitute up the family of cecropins (Suttmann *et al.,* 2008). In three leukemia cell lines (K562, U937 and

THP-1) and two non-cancerous cells cecropin treatment evinced cytotoxic activity against cancerous cells in a dose dependent manner. In two non-cancer cells such as human embryonic kidney cells 293 (HEK-293) and peripheral blood mono nuclear cells (PBMCs), cecropin A treatment revealed no cytotoxicity even at highest concentrations (Sang *et al.,* 2017). It inhibited cell proliferation at the IC_{50} value of 220.05 µg/ml in bladder cancer cell line. Malignant transformed cells were damaged by the lysis and antiproliferative action of cecropin, while benign fibroblast cells were exempted from the cytotoxic effects (Suttmann *et al.,* 2008).

Poecilocorisin- 1, a peptide isolated from red striped golden stink bug, *Poecilocoris lewisi* was noted with cytotoxic effect against malignant melanoma cells SK-MEL-28, G361 and lethal effects were not observed in human epithelial cell HaCaT. Its anticancer effect was evinced by the reduction in expression of transcription factor Sp1. This transcription factor levels are usually higher in tumour cells as they are highly correlated with cell cycle progression and the mice deleted with Sp1 were encountered with less incidence of metastasis (Lee *et al.,* 2021). Gomesin, a peptide isolated from the haemocytes of spider *Acanthoscurria gomesiana* displayed antitumor effect in mouse melanoma and repressed the cell proliferation in various cancer cell lines (Tanner *et al.,* 2018).

10. **Wasp Derived Peptides:** Anoplin, a short peptide made of ten amino acids is present in spider wasp *Anoplius samariensis.* It exhibits cytotoxicity in tumor cells as it disturbs the integrity of cell membrane. It exposed anti-proliferative effect in murine erythroleukemia cells in a concentration and time dependent manner. Decoralin from Eumenine wasp *Oreumenes decorates* anticancer effect in MCF-7 breast cancer cell with an IC50 of 12.5µmol/L. Polybia-MP-1 a venom of social wasp *Polybia paulista*, is a peptide contained 14 amino acids. It suppressed the proliferation of cancer cells and manifested significant inhibition in prostate cancer PC-3 cell line, bladder cancer cell lines (Biu87 and EJ) and human umbilical vein endothelial cell lines at different IC50 concentrations (Abd El Wahed *et al.,* 2021).

11. **Milk Derived Peptides:** Lactoferrin, a peptide of cationic iron binding protein with a size of 80kDa and contains 700 amino acids mostly isolated from the milk and colostrum has proven with various pharmacological effects like antioxidant, anti-inflammatory and anticarcinogenic properties. LF has the propensity to regulate cytokine generation in cancer, exactly as it does in inflammation. In in vitro models, LF halts the tumour cell viability and deterred the conversion of cells from G1 to S phase of cell cycle (Gonzalez Chavez *et al.,* 2009). In HepG2 and Jurkat cells, supplementation with bovine lactoferrin exhibited cellular apoptosis by intrinsic pathway and inhibited cell viability. It demonstrated synergistic anticancer action with conventional drugs like cisplatin and etoposide (Arredondo Beltran *et al.,* 2023). Camel milk is an exceptional and compelling protein repository, and its bioactive peptides can augment the health and nutrition of humans as a beneficial medication. Proteins seen in camel milk are generally of two categories as casein and whey proteins. The first group casein includes α S1, α S2, β and κ casein and whey proteins comprises of lactophorin, serum albumin, lactoferrin, α-lactalbumin and immunoglobulins (Mohamed *et al.,* 2022). Due to the absence of detrimental effects and the recognition that various anticancer peptide-based drugs have actually been authorised, the utilisation of the enzymatic hydrolysates of dietary proteins

as anticancer weapons is an appropriate approach for the fabrication of peptide-based drugs. Whey protein hydrolysates synthesized by trypsin and pepsin had demonstrated anticancer effect against MCF-7 breast cancer cell line at the concentration of 400 μg/ml (Taghipour *et al.,* 2023) and similar effect was detected in HCT 116 cell line treated with same hydrolysates by pepsin alone at 221 μg/ml (Murali *et al.,* 2021).

12. **Hepcidin:** Hepcidin, a 25 amino acid contained peptide is released by the hepatocytes of liver and it takes part a prime role in iron homeostasis and acute phase response during inflammation. The liver is reported to have maximum scale of hepcidin expression at the mRNA level, followed by the brain, pancreas, parotid gland, heart, and adrenal gland (Wang *et al.,* 2021). in myeloma U266 cells resistant to melphalan, hepcidin triggered cytotoxicity an in a concentration and time dependent manner and it elicited lysis effect through the formation of pores in the myeloma cell membrane. In the membrane damaged cells hepcidin induced DNA fragmentation as a result of mitochondrial disruption and concurrent caspase stimulation as the supplemental factors (Conrad *et al.,* 2021).

13. **Melittin:** Melittin is a short linear peptide of basic nature which contains 26 amino acid sequences with a molecular weight of 2847.5 Da. This molecule is exclusively seen in the venom of bee and act as a toxin. In leukemic cells, melittin promoted apoptosis with Bax and caspase upregulation and downregulates BCl-2 protein. Its apoptotic effect on prostate cancer cells is attributed to its interference in nuclear factor kappa B (NF-κB) / caspase signal pathway. In vivo administration of melittin in murine model induced with hepatocellular carcinoma showed drastic reduction in metastasis and tumor weight (Gajski and Garaj Vrhovac,2013). By controlling mitochondrial paths, melittin administration promotes apoptosis in human gastric cancer (SGC-7901) cells. In head and neck squamous cell carcinoma, melittin therapy arrested cell growth and lowered the scale of VEGF and HIF-1 protein transcription, which have been associated with hypoxic cell radio resistance. Due to its anti-hypoxic propensity, it served as the potent sensitizer of radiotherapy (Pandey *et al.,* 2023).

14. **Dietary Peptides:** Dietary peptides are fragments of protein or short sequences of amino acids that are generated during the preparation of foods, such as fermentation and hydrolysis, or during enzymatic digestion in the gut (Kitts and Weiler, 2003). These chains of amino acids are liberated from parent proteins by fragmentation or disintegration. In the small and large intestine, it is released from dietary protein source and exhibit biological function. Size of the peptides usually ranges from 2- 20 amino acid molecules (Gonzalez Montoya *et al.,* 2017).

Pepsin digestion of lactoferrin results in the production of lactoferricin (LFcin), which is an effective antimicrobial peptide. N-terminal amino acid residues from 1-45 of human lactoferrin constitute the portion of LFcin. LF11, a fragment of human LFcin which is made up of 11 amino acid residues. A mutant of LF11 also known as PFR peptide, was assessed for its cytotoxic activity. in murine erythroleukemia and human promyelocytic leukaemia cells, PFR peptide triggered cell death and inhibited the multiplication of cells. Its toxic effect on healthy cells were assessed by its action on normal bone marrow cells which revealed no considerable alterations in cell morphology and its proliferation. In addition, it had no effect on the apoptotic pathways which was evident by the absence of apoptotic bodies in treated cells whereas the treated cells had

been found with necrotic features which was seen by Annexin V and PI staining assay (Lu *et al.,* 2016).

15. **Snake Venom Derived Peptides:** Crotamine, a peptide present in the venom of rattle snake *C. durrisus terrificus* has the tendency to cause neurotoxicity and myotoxicity. In the melanoma cell line, it exhibited cytotoxicity at 5µg/ml and in in vivo melanoma model, it reduced the tumour weight and enhanced the lifespan of tumour induced animal compared to control groups (Periera *et al.,* 2011). Crotalicidin, a peptide composed of 34 aa was found in the South American rattle snake and inhibited the cell proliferation at the dose of 5µM in leukaemia cell line. Despite it tends to intervene with essential cellular biochemical pathways, its lethal effect towards leukaemia cells has been attributed to membranolytic triggered tumour cell damage and death. Pancreatic cancer cells PaTu 8990t were infused and incubated with venom of *Ophiophagus hannah* have been manifested with significant cytopathic effects after 4 hrs of incubation and meanwhile after 12 hours of treatment, cells were perceived with conspicuous transformations in its morphology. Moreover, it detained the migration of cells which was detected by the proportion of confluence after treatment. Apoptotic bodies were evinced in moderate and less concentration of venom whereas it was not existed at high venom doses. Injection of PaTu 8990T cells into the zebrafish embryos through perivitelline route can elicit and trigger angiogenic response as it is of pro-angiogenic nature. Angiogenesis was completely hampered and retarded in *O. hannah* venom administered cells (Kerkkamp *et al.,* 2018).

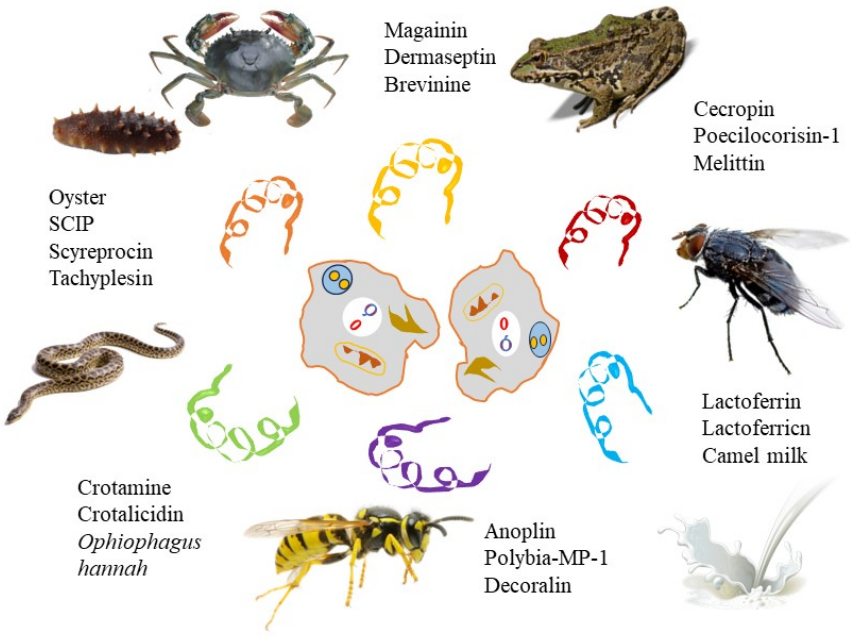

Figure 1: Graphical representation of peptide from different sources

III. CONCLUSION

Bioactive constituents have been documented to be an efficient anti-tumor medication that hits numerous cancers associated sequential cascade with its pleiotropic and synergistic effects when combined with chemotherapy. Therapeutic peptides are an alluring anti-cancer tools owing to their low cytotoxicity, specificity, tendency to get into tumour cells, very small size, and ease of manipulation. The research findings and outcomes strongly imply that peptides may act as tumour suppressors in the future as a drug candidate.

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