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Curcumin (*Curcuma longa*) and quercetin nanoparticles as antimicrobial and anticancer agents

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ABSTRACT

This study was achieved to evaluate the anticancer and antibacteria activities of curcumin and quercetin naoparticles. Also, the chemical, minerals content, total phenolic, total flavonoids compounds, and DPPH radical scavenging activity of curcumin were determined. The results indicated that the curcumin contains high amounts of protein and total carbohydrates, in addition to lower levels of ash, crude fiber, and total lipids. The total phenolic and flavonoids and the DPPH radical scavenging activity were estimated at different concentrations of curcumin extract (10, 20, 30, 40, and 50 µg/ml) with different solvents (ethanol, ethyl acetate, chloroform, and water). The results showed that the ethanol extract had high amounts from total phenolic and flavonoids and the highest DPPH radical scavenging activity followed by ethyl acetate, chloroform, and water.

The effect of the prepared nanoparticles of curcumin and quercetin extracts were studied as preventive to MCF-7 human cancer breast and as antibacterial for Streptococcus aures, Streptococcus penoenumoia and Bacillus substilis (Gram-positive bacteria), Escherichia coli, Salmonella typhimrium and Pseudomonas aeruginosa (Gram-negative bacteria). The results showed that the curcumin and quercetin nanoparticles extracts were significantly increased cell cytotoxicity, from the minimum to maximum concentrations ranging from 6.25 to100 µg/ml which inhibit these cells from 3.21 to 87.53% using nanoparticles of curcumin and 40.34 to 73.93% by quercetin. The effect of curcumin and quercetin nanoparticles on gram-positive and negative bacteria showed that the highest inhibition zone in gram-positive bacteria and gram-negative bacteria was at 100µg.

From the current results, it could be indicated that the curcumin and quercetin nanoparticles contain high amounts from nutrition factors; polyphenolics compounds, and have antioxidant activity, and DPPH scavenging radicals. In addition, they gave the best results as anticancer and antibacterial agents. Therefore, the bioactive compounds found in these natural compounds can delay MCF-7 breast cancer cell lines.

Key words: Curcumin, quercetin nanoparticles, antimicrobial, anticancer.

INTRODUCTION

Curcumin has received high attention as an antioxidant, anti-inflammatory, and anticancer agent (Tomeh *et al.*, 2019). It is a polyphenol and natural antioxidant. Turmeric powder has contained 77% curcumin; it is soluble in acetone, methanol, and ethanol (Alves *et al.*, 2019). It Curcumin is a yellow crystalline hydrophobic polyphenol and it is utilized as a traditional medicine against chronic heart diseases, and other different kinds of diseases (Gupta *et al*., 2013).

The mechanisms of action of curcumin appear as anticancer activity includes apoptosis and prevention of reproduction and forcibly put an end to a variety of cellular signaling pathways (Kunnumakkara *et al.,* 2017). Curcumin antitumor activity on breast cancer, lung cancer, etc, indicated its capability to multiple cancer cell lines. Despite all the above characteristics utilize of curcumin, its use is limited due to its low solubility in water which resulting in weakly oral bioavailability (Nagahama *et al.,* 2016).

Breast cancer has shown the leading reason of death in women despite lumpectomy, radiotherapy, and chemotherapy. It has been found that the rate of breast cancer remains high (Ananthakrishnan *et al*., 2012). Therefore, more efficient treatment strategies are still needed. In a research of human breast epithelial cells MCF-10A and breast cancer MCF-7 cells, a significant decrease in telomerase activity was noticed as a result of curcumin therapy in a concentration-dependent manner that was associated with curcumin but not through the pathway of mRNA (Ramachandran *et al.,* 2002). Bachmeier *et al.* (2007) studied the breast cancer cell lines and confirmed the ability of curcumin to down regulate to an antiproliferative influence. Furthermore, curcumin suppressed breast tumors by overexpressing the p53 gene and reducing the levels of ki-67 antigen (Moghtaderi *et al.,* 2017). Another research on MDA-MB-231 cells has shown that curcumin also inhibits inflammatory cytokines CXCL 1and 2. Inhibition of inflammatory cytokines by curcumin inhibits the expression of a series of tumor-promoting genes such as CXCR4 chemoreceptors (Bachmeier *et al.,* 2008). Dimethyl curcumin has been influential against breast cancer via inhibiting several types of steroid receptors (Verderio *et al.,* 2014).

Polymeric nanoparticles were prepared and used to encapsulate, protect, and release two bioactive flavonoid molecules, quercetin and catechin. Thus it showed that both flavonoids were successfully encapsulated in a noncrystalline state within the nanoparticles matrix. Therefore that nanoparticles could be suitable for the encapsulation of bioactive compounds (such as flavonoids and vitamins) and to release them in acidic environments, such as the stomach of some food products. These findings could also be useful for the design and fabrication of polymeric nanoparticles for the targeted release of these compounds within the stomach for thetreatment of local diseases or to release them in acidic food products, producing novel functional foods (Pool *et al.,* 2012).

Therefore, this study showed that the effect of curcumin and quercetin in the prevention and the treatment of cancer breast, and they use as antimicrobial agents. Also, the objective of this investigation is to evaluate the antioxidant possibility for these natural compounds.

MATERIALS AND METHODS

Materials

Quercetin and curcumin were purchased from Sigma-Aldrich, Singapore, and used as received. All reagents used were of technical grade. The absolute ethanol

(99.5–99.8%) was obtained from J.T. Baker (Avantor Performance materials, Phillipsburg, NJ). Poly (D,L-lactic-co-glycolic acid) (PLGA) (Resomer R503H; MW 35–40 kDa), poly (vinyl alcohol) (PVA) (MW 30–70 kDa) were obtained from were purchased from Sigma- Aldrich (St. Louis, MO, USA). Gallic acid, catechin, 1,1- diphenyl-2-picrylhydrazyl radical (DPPH), and 2,4,6-tris (2- pyridyl)-1,3,5-triazine (TPTZ) were purchased from Sigma- Aldrich (St. Louis, MO, USA). Folin-Ciocalteu's phenol reagent, and ferrous sulfate heptahydrate (FeSO4 7H2O) were purchased from Merck Co. (Darmstadt, Germany). All of the chemicals and reagents used in this study were of analytical grade.

Butelate hydroxyl anisole (BHT) as synthetic antioxidant were obtained from Sigma-Aldrich (Pozna´ n, Poland),

Methods

Chemical composition and minerals content of curcumin

Chemical composition as moisture, crude protein, ether extract, ash, crude fiber, and carbohydrates was determined by using the methods of the AOAC (2012). Minerals content (Na, Ca, and K) were determined in the diluted solution of ash samples by using an emission flame photometer (Model Corning 410). The other minerals (Zn, P, Fe, and Mg) were determined by the Atomic absorption spectrophotometer (Perkin – Elmer Instrument Model 2380) according to the method of AOAC (2012).

Preparation of curcumin and quercetin extracts

Dried powder of each of curcumin or quercetin (10 g) was dispensed in 100ml for each of distilled water, ethanol, ethyl acetate and chloroform, overnight at room temperature using shaker. The mixture was filtered through Whitman No 1 filter paper and the extraction step was repeated twice. The filtrate was then concentrated to dryness at 40 °C in a rotary evaporator. The crude extracts were stored in a refrigerator until further analysis according to Kang (2015).

Estimation of total phenolic acids and flavonoids compounds of curcumin and quercetin

The total phenolic content in the mulberry extract was measured using the method of Qawasmeh *et al.* (2012) with Folin-Ciocalteu reagent. The UV reading was measured at 760 nm. Gallic acid was used as standard (1 mg/ml) and the results were expressed as gallic acid equivalent (GAE mg/100g of dry weight).

The total flavonoids content was determined by the method of Eghdami and Sadeghi (2010). The absorbance was measured against a blank solution at 510 nm and the total flavonoids content was expressed in terms of milligrams of quercetin equivalent (mg QE /100g DW).

Antioxidant activity

DPPH· (1,1-Diphenyl-2-picrylhydrazyl) Free radical scavenging assay

Determination of Butyl Hydroxy Toluene (DPPH)· free radical scavenging activity was measured in green banana according to Ravichandran *et al.* (2012). BHT, Sigma was used as positive control, while the negative control is contained the entire reaction reagent except the extracts. Then the absorbance was measured at 515 nm against blank. The capacity to scavenge

the DPPH· radical was calculated using the following equation:

DPPH· scavenging effect (Inhibition %) = [(Ac – As / Ac) × 100]

Where: Ac is the absorbance of the control reaction.

As is the absorbance in the presence of the plant extracts

Preparation of curcumin nanoparticles

Nanoparticles loaded with curcumin were prepared by a modified emulsion–diffusion–evaporation method, previously reported with Devadasu *et al.* (2011). Briefly, curcumin (7.5 mg) and Poly (lactide -co- glycolide) acid (PLGA) (50 mg) were dissolved in 2.5 ml of ethyl acetate and stirred at 1,000 rpm for 30 min under room temperature to obtain a homogeneous solution. Either Polyvinyl alcohol (PVA) (50 mg), used as a stabilizer, was dissolved in 5 ml distilled water. The organic phase containing the active ingredient and PLGA was then added in a drop-wise manner to the stabilizer solution during homogenization. Homogenization was continued for 5 min at 15,000 rpm. After this step, the emulsion was transferred to 20 ml water to facilitate diffusion and was stirred overnight to ensure the complete evaporation of the organic solvent. After the evaporation step was complete, the nanoparticles solution was centrifuged at 15,000×g for 15 min to separate free active ingredient and any unbound stabilizer in the solution. The supernatant was separated and the pellet was redispersed in 20 ml water then the curcumin nanoparticles with PVA.

Preparation of quercetin nanoparticles (QUNPs)

Quercetin were prepared by adding ethanol to water volume ratio (1:35), fixed flow rate (10 ml/min) under magnetic stirring (1000 rpm) according to the nano participation technique according to Kakran *et al*. (2012) and Abd El-Rahmanand and Al-Jameel (2014). Quercetin was dissolved in the solvent (ethanol) at predetermined concentration of 5mg/ml. The syringe was filled with the prepared solution and secured onto a syringe pump. Drug solution was quickly injected at a fixed flow rate into the anti-solvent (deionized water) of definite volume under magnetic stirring. The QUNPs were filtered and vacuum dried.

Human cell lines

Potential human cell lines: MCF-7 breast cancer cell lines (human cancer breast) were obtained from VACSERA Tissue Culture Unit and were tested using the method of **Gomha *et al.* (2015).**

Antimicrobial activity

The antimicrobial activity of samples was determined using agar well diffusion method Scott (1989). Ethanol extract from Curcumin and quercetin nanoparticlessize were tested in vitro for their antibacterial activity against *Streptococcus aures, Streptococcus penoenumoia* and *Bacillus substilis* (Gram-positive bacteria), *Escherichia coli, Salmonella typhimrium* and *Pseudomonas aeruginosa* (Gram-negative bacteria) using nutrient agar medium. Curcumin and quercetin nanoparticles were dissolved in a 70% ethanol solution. In addition, the curcumin

and quercetin nanoparticles solvent was assayed at concentrations of 25, 50, 75, and, 100 µg/ml.

Method of testing

The sterilized media was poured onto the sterilized Petri dishes (20 ml, each Petri dish) and allowed to solidify, in addition, the concentration of different positive and negative bacterial was adjusted as 5x105 CFU/ml. Filter paper wells of 6 mm diameter were made in the solidified media with the help of a sterile borer. A sterile swab was used to evenly distribute microbial suspension over the surface of solidified media and curcumin nanoparticle extract was added to each filter paper well with the help of a micropipette at different concentrations 25, 50, 75, and 100 ug/ml. The plates were incubated at 37°C for 24 hrs in case of antibacterial activity. The diameter of the zones of inhibition around each of the wells was taken as a measure of the antibacterial activity. Each experiment was carried out in triplicate and the mean diameter of the inhibition zone was recorded.

Statistical analysis

Means ± SD of the results are statistically analyzed using one-way analysis of variance (ANOVA), $p \leq 0.05$ was used to indicate significance. Statistical software (Assistat Version 7.7, Brazil) was used for all statistical analyses according to Silva and Azevedo (2009).

RESULTS AND DISCUSSION

Chemical composition and minerals content in curcumin

The result in Table (1) showed that curcumin contains moisture, ash, crude fiber, and total lipids and their percentage were 9.21, 4.32, 6.54, and 3.76 %., respectively. In addition, it contains 10.38 % crude protein and 74.00 % total carbohydrates. This implies curcumin could be a good source of protein and carbohydrates and it was lower in ash, crude fiber, and total lipids. Turmeric had contained a reasonable amount of ash and minerals. The fiber in turmeric removes possible carcinogens from the body and prevents excessive intake of starchy foods, thus may protect against metabolic conditions such as hypercholesterolemia and diabetes (Bamishaiye *et. al*., 2011).

Ahamefula *et al.* (2014) found the chemical composition of curcumin from moisture, ash, crude protein, crude fiber, and fat were 8.92, 2.85, 9.42, 4.60, and 6.85, respectively. In addition, turmeric contents often vary with species, locations, and cultivation conditions, while there are significant variations in the constituent of turmeric oil with various cultivars. (Li *et al.*, 2011). In the present study curcumin contains calcium, phosphorus, potassium, iron, magnesium and Sodium (0.17, 0.71, 0.41, 0.03, 0.28 and 0.02 %, respectively). Thus, continuous curcumin feeding could be of great significance in maintaining bone strength, muscle contraction and relaxation, lowering blood pressure, and aiding in hemoglobin formation (Kubmarawa *et al.*, 2007). Calcium is a key agent in

maintaining bone strength and absorption of vitamin B12, potassium, and magnesium and is known to lowering blood pressure. Potassium is controlling skeletal muscle contraction and transmission of nerve impulses, and patients with soft bone problems nutrition on diets great in calcium and potassium (Kubmarawa *et al.,* 2007).

The iron content in curcumin extract can aid in the formation of hemoglobin (Latunde - dada, 1980) and is therefore recommended for iron shortage anemia. Several minerals are also coenzymes involved in certain biochemical reactions in the body which underlines the significance of the plant in metabolic reactions.

Table (1). Chemical and minerals content in curcumin on dry weight (g/100g)

Chemical composition	Curcumin	Minerals content	Curcumin
Moisture	9.21±0.83	Calcium	0.17±0.01
Protein	10.38±0.91	Phosphorus	0.41±0.02
Total Fat	1.76±0.02	Magnesium	0.28±0.01
Crude fiber	6.54±0.04	Potassium	0.71±0.81
Ash content	4.32±0.03	Iron	0.03±0.00
Total carbohydrates	77.00±6.24	Sodium	0.02±0.00

Values are mean and SD (n = 3)

Total phenolic acids and flavonoids compounds in of curcumin extracts

Total phenolic and flavonoids compounds were determined in curcumin at different extracts (aqueous, ethanol, ethyl acetate and chloroform) and the results are reported in Table (2). From the results, it could be observed that the curcumin ethanol extract had the highest total phenolic and flavonoids compounds by 55.35 mg/100 GAE and 40.12 mg/100 QE followed by ethyl acetate (32.21 mg/100 GAE and 25.37 mg/100 QE) and chloroform was 25.39 mg/100 GAE and 17.16 mg/100 QE, respectively. Meanwhile, curcumin aqueous extract had the lowest in total phenolic and flavonoids compounds by 15.69 mg/100 GAE and 10.94 mg/100 QE, respectively. The results showed that the ethanol extracted from turmeric gives the greatest efficient extraction of total phenolic content and also, followed by ethyl acetate, chloroform, and aqueous. A greater total phenolic content in turmeric extraction with ethanol solvent may be due to the fact that the main phenolic compounds of turmeric had contained a long, non-polar chain of carbon-carbon covalent bonds with a phenolic group attached to the ends (Shen and Ji, 2012). The structure allows them to dissolve most freely in ethanol followed by ethyl acetate, chloroform, and partially in water. In addition, curcuminoids are practically insoluble in water, and this explain the low level of total flavonoids in the water extract (Sindhu *et al.,* 2014).

Curcumin acts as controller of epinephrine endogenous oxidation, and it produce free antifungal that is just as potent as superoxide dismutase (Fuertes Ruitón *et*

al., 2014). Moreover, curcuminoids inhibit lipid oxidation and prevent food degradation due to the fact that it acts as a trap and scavenging free radicals, thus stimulating enzymatic activity, protecting the organism from aging, and rebuilding biological structures (Stanojević *et al.*, 2015).

Table (2). Total phenolic acids and flavonoids compounds in of curcumin extracts

Curcumin Extracts	Total phenolic acids mg/100 GAE	Total flavonoids compounds mg/100 QE
Aqueous	10.69±0.57[d]	6.94±0.38[d]
Ethanol	55.35±2.3.28[a]	40.12±3.28
Ethyl acetate	32.21±2.63[b]	25.37±1.69 [b]
Chloroform	25.39±1.58 [s]	17.16±0.85 [c]

Values are mean and SD (n = 3); where: Mean with the same letter are significantly different at $p<0.05$ levels.

Antioxidant activity of curcumin extracts at different concentrations

The antioxidant activity was estimated by the 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical scavenging activity. The scavenging activity of curcumin extracts at different concentrations and compared with BHT as synthetic antioxidant were determined and the results are tabulated in Table (3). The results indicated that when the concentration of curcumin increased in different extracts the DPPH scavenging activity was increasing. Thus, it could be found that the curcumin extract at 50µg/ml had the highest scavenging activity in ethanol extract followed by ethyl acetate, chloroform, and aqueous (55.82, 47.28, 43.24, and 40.11%, respectively). The BHT as the standard antioxidant has the highest DPPH scavenging activity and IC_{50} value by 62.38% and 22.35µg/ml. Moreover, the IC_{50} values in the different extracts (ethanol, ethyl acetate, chloroform, and aqueous) from curcumin were 30.18, 45.95, 55.28, and 80.15 µg/ml, respectively. The results indicated that the free radical scavenging activity of curcumin can be due to the presence of high amounts of natural antioxidants with higher reductive capacity. Surojanametakul *et al.* (2010) found that when the concentration of turmeric increases, the free radicals absorption by DPPH were decreased, and it is elevating sensitivity to radical scavenging. In general, the ethanol extract had contained high amounts of antioxidant characteristics than those in the aqueous extract (Tanvir *et al.*, 2017).

Table (3). DPPH· scavenging activity of curcumin extracts at different concentrations

Curcumin Extracts	Scavenging activity %					IC_{50} µg/ml
	10µg/ml	20µg/ml	30µg/ml	40µg/ml	50µg/ml	
Aqueous	20.15±1.12 [e]	22.38±1.42 [e]	27.59±2.28[e]	32.91±2.58 [e]	40.11±3.21 [e]	80.15±5.11 [a]
Ethanol	40.26±2.31[b]	44.38±3.38 [b]	48.49±4.12 [b]	51.67±4.13 [b]	55.82±4.17 [b]	30.18±2.83[d]
Ethyl acetate	35.15±2.83 [c]	37.27±3.14 [c]	41.62±3.43 [c]	43.38±3.635 [c]	47.28±4.35[c]	45.95±4.21[c]
Chloroform	30.38±2.19[d]	35.28±2.34[d]	37.12±2.46 [d]	40.29±3.29[d]	43.24±3.81[d]	55.28±4.78 [b]
BHT as standard	45.29±3.27[a]	47.38±3.64 [a]	51.11±4.14 [a]	55.29±4.18 [a]	62..38±5.27 [a]	22.35±1.56[e]

Values are mean and SD (n = 3); where: Mean values with the same letter are significantly different at $p<0.05$ levels

Effect of curcumin nanoparticles on breast cancer human cell lines

The effect of curcumin nanoparticles extract at different concentrations as anticancer of MCF-7 cancer cell lines was determined and the results are found in Table (4). The results indicated that curcumin nanoparticles extract resulted in a marked elevate in the cytotoxicity of cells, and their inhibition reached to 87.53% with 100 µg/ ml curcmin nanaoparticles. This inhibition can be related to the presence of polyphenolics and flavonoids compounds in curcumin nanoparticles which can exhibit cytotoxic activity against breast carcinoma cells (MCF-7). Phytochemicals are flavonoids that have been brought to a place of great benefit for being a powerful antioxidant with some anticancer effects. Its structure contains a double bond in the C-ring and a 4-oxo group, which increases its antioxidant activity (Moskaug *et al.*, 2004).

Also, the present results were consistent with Sundarraj *et al.* (2012) who found that the bioactive components contained anticancer potential through different mechanisms that included suppression of signaling pathways, induction of death, and cell cycle arrest. Moreover, Swanson (2015) studied the effect of curcumin on MCF-7 tumor cells and normal cells, the results found that the cytotoxic influence of MCF-7 cells was increased than that of normal cells at 50% curcumin extract concentration, and this cytotoxic influence may be due to the apoptotic influence. At 75% concentration, the cytotoxic influence was detected with necrosis. Furthermore, excessive production of free radicals will be exacerbated by oxidative damage to proteins, lipids, and DNA, and even lead to cell death.

Table (4). Effect of curcumin nanoparticles on breast cancer human cell lines

Concentration µg/ ml	Viability %	Inhibitory %	S.D. (±)
0	100	00	00
6.25	96.79	3.21	0.65
12.5	90.70	9.30	1.24
25.0	74.59	25.05	1.86
50.0	63.73	36.27	2.15
100.0	12.47	87.53	1.38

Effect of quercetin nanoparticles on breast cancer human cell lines

The effect of quercetin nanoparticles extract against human breast cancer was estimated and the results are shown in Table (5). It was found that this extract had significant activity against the MCF-7 cell line. The highest inhibition ratio was 76.93% from quercetin nanoparticles at a concentration 100µg/ml which may be caused due to their natural antioxidant activity against cancer. The minimum inhibition was observed at concentrations 6.25, 12.5 and 25.0 µg/ml and the inhibition cell lines were 40.34, 42.16, and 48.36%, respectively. This means that the greatest concentration of quercetin nanoparticles

becomes greater in inhibition the growth of MCF-7 cell line.

Quercetin is a powerful flavonoid and it has toxic effects on many types of cancer cells (Srivastava *et al.,* 2016). However, the weak solubility and decreased bioavailability of quercetin have limited their treatment applications (Rauf *et al.,* 2018). Various drug systems, like polymeric nanoparticles, and solid lipid nanoparticles, have been investigated to increase the bioavailability of anticancer agents (Wang *et al.,* 2017). Li *et al.* (2018) demonstrated that the quercetin nanoparticles are influential in decreasing the cell population and viability of MCF-7 cells through growth inhibition and induction of cell death.

Table (5): Effect of quercetin nanoparticles on breast cancer human cell lines

Concentration µg/ ml	Viability %	Inhibitory %	S.D. (±)
0	100	00	00
6.25	59.66	40.34	3.15
12.5	57.84	42.16	2.97
25.0	51.64	48.36	2.39
50.0	41.54	58.46	3.49
100.0	23.07	76.93	1.28

Curcumin and Quercetin nanoparticles as antimicrobial agent

Antibacterial activity was studied with the ethanol extract from curcumin and quercetin nanoparticles at different concentrations (25, 50, 75, and100 µg/ml), as well as, agar well diffusion method was used to determine the zone of inhibition of gram-positive and gram-negative bacterial growth, and the results are reported in Tables (6 and 7).

The results in Table (6) indicated that the curcumin extract was gradually inhibiting zone from concentration 25µg to 100µg in gram-positive and gram-negative. In addition, the highest inhibition zone in gram-positive bacteria was *Bacillus subtitles, Streptococcus aureus,* and *Streptococcus penoenumoia*. Whilst, in gram-negative bacteria the highest inhibition zone was *Escherichia coli* and *Salmonella typhimurium*. Also, the curcumin nanoparticles extract at 100µg had not detected effect on *Salmonella typhimrium*. The ethanol extract of curcumin showed considerable inhibitory effects against *Escherichia coli, Streptococcus, Staphylococcus, Bacillus cereus, Micrococcus, Pseudomonas, Aspergillus,* and *Penicillium* at a final concentration of 20 mg/ml. Ahamefula *et al.* (2014) found that the zone of inhibition shown by the plant extracts against the tested organisms ranged from 7.0 to 20.0 mm. Shagufta *et al*. (2010) observed that curcumin at different concentrations has significant inhibitory activities against all tested bacterial strains. The mechanism of the antibacterial activity of curcumin seems to differ depending on the strain. In the current study, the curcumin

nanoparticles showed stronger antibacterial activity against *Escherichia coli* which was similar to the observation of Basak *et al.*, (2018).

Table (6). Curcumin nanoparticles as antimicrobial agent

	Concentration (µL)			
	25	**50**	**75**	**100**
***Gram-positive* (mm)**				
Streptococcus aures	3.5±0.12	9.0±0.73	15.0±1.25	39.5±2.72
Streptococcus penoenumoia	8.8±0.73	13.0±1.02	24.3±1.87	38.9±3.12
Bacillus subtitles	12.0±0.91	19.8±1.35	36.1±2.38	50.0±4.28
***Gram-negative* (mm)**				
Pseudomonasaeruginous	ND±00	ND±00	ND±00	ND±00
Escherichia coli	8.5±0.53	12.5±0.98	30.6±2.86	48.0±3.59
Salmonella typhimrium	5.9±0.28	10.0±0.95	19.2±1.28	30.1±2.18

Values are mean and SD (n = 3) ND = not detect

The results in Table (7) indicated that using 100µg of quercetin nanoparticles had an antimicrobial impact on gram- positive and gram-negative bacteria. The highest inhibition zones was observed in gram-positive bacteria *Bacillus subtitles, Streptococcus aureus,* and *Streptococcus penoenumoia* at concentrate (59.3, 43.4 and 41.7 mm, respectively). Meanwhile, in gram-negative bacteria the highest inhibition zones at concentrate 100µg was for *Escherichia coli* and *Salmonella Typhimurium* (54.3 and 35.0 mm, respectively). On the other hand, the quercetin nanoparticles concentrations 25, 50 and 75 µg had no detected effect. While, inhibition zone was observed at 100 µg of quercetin nanoparticles on *Salmonella typhimrium* (5.0mm). *Salmonella typhimurium, Escherichia coli* , and *Staphylococcus aureus* were selected as model bacteria due to their being food borne pathogens. The results of antimicrobial activity estimated by three various methods observed that the antimicrobial activity of quercetin nanoparticles was influential on gram-positive bacteria (*Lactobacillu. monocytogenes and Staphylococcus aureus*) (Arasoğlu *et al.*, 2017).

Natural bioflavonoid is an absolutely necessary component of nutritional supplements possessing antimicrobial characteristics. The synergistic connection between nanoscience and flavonoid chemistry enhances the epidemiological characteristics of flavonoids and also reduces antimicrobial resistance through the formation of their hybrid nanocomposites and biosensing nanomaterials for flavonoids and their drug delivery (Parhi *et al.*, 2020).

Table (7). Effect of quercetin nanoparticles as antimicrobial agent

	Concentration (µg)			
	25	50	75	100
***Gram-positive* (mm)**				
Streptococcus aures	6.4±0.61	8.6±0.71	18.7±1.15	43.4±3.24
Streptococcus penoenumoia	10.9±0.94	16.2±1.25	29.2±2.04	41.7±3.18
Bacillus subtitles	12.8±1.12	23.2±1.97	44.2±3.46	59.3±4.53
***Gram-negative*(mm)**				
Pseudomonas aeruginous	ND±00	ND±00	ND±00	5.0±0.07
Escherichia coli	10.1±0.92	22.4±2.01	45.0±4.21	54.3±4.39
Salmonella typhimrium	11.3±1.13	14.0±0.85	19.2±1.53	35.0±2.68

Values are mean and SD (n = 3) ND = not detect

CONCLUSION

Curcumin and quercetin nanoparticles exhibit anticancer influence against MCF-7 cells (breast cancer cell line) as well as antibacterial agents. Their role in health status may be due to the presence of bioactive compounds as natural antioxidants. It is recommended to use them in diary food as a preventative and to lower considerable side effect of cancer from chemical drugs.

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الكركمين (كركم لونجا) وجسيمات كيرسيتين النانوية كعوامل مضادة للميكروبات ومضادة للسرطان

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المستخلص

أجريت هذه الدراسة لتقييم النشاطات المضادة للسرطان والبكتيريا لجزيئات الكركمين والكيرسيتين. كما تم تحديد المحتوى الكيميائي والمعدني ومركبات الفينول الكلية ومركبات الفلافونويد الكلية ونشاط الكسب الجذري DPPH للكركمين. أشارت النتائج إلى أن الكركمين يحتوي على كميات عالية من البروتين والكربوهيدرات الكلية ، بالإضافة إلى انخفاض مستويات الرماد والألياف الخام والدهون الكلية .تم تقدير إجمالي الفينول والفلافونيدات ونشاط الكسح الجذري لـ DPPH بتركيزات مختلفة من مستخلص الكركمين (10 ، 20 ، 30 ، 40 ، 50 ميكروغرام / مل) بمذيبات مختلفة (إيثانول ، أسيتات إيثيل ، كلوروفورم ، وماء). أظهرت النتائج أن مستخلص الإيثانول يحتوي على كميات عالية من الفينول والفلافونويدات الكلية وأعلى نشاط لكسح جذور DPPH يليه أسيتات الإيثيل والكلوروفورم والماء.

تمت دراسة تأثير الجسيمات النانوية المحضرة من مستخلصات الكركمين والكيرسيتين على أنها وقائية لسرطان الثدي البشري MCF-7 وكمضاد للبكتيريا للمكورات العقدية والمكورات العقدية والعصيات الفرعية (بكتيريا موجبة الجرام) والإشريكية القولونية والسالمونيلا التيفية والزائفة. البكتيريا سالبة الجرام). أظهرت النتائج أن مستخلصي الجسيمات النانوية من الكركمين والكيرسيتين زاد بشكل كبير من السمية الخلوية للخلايا ، من الحد الأدنى إلى الحد الأقصى للتركيزات التي تتراوح من 6.25 إلى 100 ميكروغرام / مل مما يثبط هذه الخلايا من 3.21 إلى 87.53٪ باستخدام الجسيمات النانوية من الكركمين و 40.34 إلى 73.93٪ بالكيرسيتين. أظهر تأثير جزيئات الكركمين والكيرسيتين النانوية على البكتيريا موجبة وسالبة الجرام أن أعلى منطقة تثبيط في البكتيريا موجبة الجرام والبكتيريا سالبة الجرام كانت عند 100 ميكروجرام.

من النتائج الحالية ، يمكن الإشارة إلى أن جسيمات الكركمين والكيرسيتين النانوية تحتوي على كميات عالية من عوامل التغذية ؛ مركبات البوليفينول ، ولها نشاط مضاد للأكسدة ، وجذور DPPH الكاسحة. بالإضافة إلى ذلك ، فقد أعطت أفضل النتائج كعوامل مضادة للسرطان والبكتيريا. لذلك ، يمكن للمركبات النشطة بيولوجيًا الموجودة في هذه المركبات الطبيعية أن تؤخر خطوط خلايا سرطان الثدي.MCF-7