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SYNTHESIS AND CHARACTERIZATION OF ZINC OXIDE NANOPARTICLES LOADED WITH *CARDIOSPERMUM HALICACABUM* ALCOHOLIC EXTRACT.

Md. Furqan [1*], Dr. Pawan Kumar [2], Dr. Seema Firdouse [3], Dr. Parwez Alam [4].

[1, 2] Department of Pharmaceutics, Singhania University, Pacheri bari, Jhunjhunu, Rajasthan-333515.

[3] Anwarul Uloom College of Pharmacy, Hyderabad, Telangana-500001

[4] Shadan College of Pharmacy, Peerancheru, Hyderabad, Telangana-500091

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Abstract:

In the present study, the use of natural herb i.e, Cardiospermum halicacabum has various medicinal applications including treatment of rheumatism, abdominal pain, dropsy, lumbago, skin diseases, cough, nervous disorders etc., Zinc oxide nanoparticles were loaded with Cardiospermum halicacabum aerial part extract and were synthesized successfully by the chemical reduction method. Nanotechnology deals with the processing of separation, consolidation, and deformation of materials by one atom or by one molecule. The foremost conditions for the synthesis of nanoparticles are the selection of green or environment-friendly solvent, a good reducing agent, and a harmless material for stabilization. Zinc oxide nanoparticles, loaded with Cardiospermum halicacabum aerial part extract. A detailed characterization of synthesized nanoparticles was carried out using different techniques such as UV visible spectroscopy, Fourier transforms infrared spectroscopy (FT- IR), X-Ray diffraction (XRD), Differential scanning calorimetry (DSC), Thermogravimetry analysis (TGA), Scanning electron microscopy(SEM). A Quantitative technique (UV-vis spectroscopy) is used to measure the absorption and transmission of synthesis nanoparticles as a function of wavelength. The XRD studies are used to analyze the structure and nature of the synthesized nanoparticles. Scanning electron microscopy (SEM) is used to analyze to obtain a high- resolution image of the size and morphological of synthesized nanoparticles. Thermal analytical techniques such as TGA &DSC are used for the determination of thermal properties at different conditions as mass, heat, temperature, and time.

Key Words: *Nanoparticles, Drug delivery carrier, Cardiospermum halicacabum, Characterization.*

Corresponding author:

Md. Furqan,

Research scholar, Department of Pharmaceutics,
Singhania University, Pacheri bari, Jhunjhunu, Rajasthan-333515.
Email Id- mohdfurqan22@gmail.com
Mob. No. 9920890857

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INTRODUCTION:

Nanoparticles are the hollow structures of size ranging 1-100nm. They form different structures. It has applications in medicine, physics, optics and electronics. Nanoparticles are being investigated as potential drug delivery systems to achieve the most desirable biological outcomes. For analytical applications, the cavities are exploited for the entrapment of signalling molecules for specific targeting[1]. Zinc oxide (ZnO) shows antimicrobial action against wide range of bacterial species including gram negative and gram-positive bacteria. The synthesis of ZnO nanocomposites can be carried out by using various methods such as evaporation, pulse laser deposition, sol-gel method[2], etc. The ZnO nanoparticles manufactured in the absence of GA showed less antibacterial activity when compared to GA–ZnO nanoparticles. This can be related to the decrease in the average size of the particles when GA is used to stabilize the ZnO nanoparticles[3].Titanium dioxide (TiO_2) is used as a pigment in food products, cosmetics, nano research, etc. The clinical analysis indicate that the TiO_2 nanoparticles enters the systemic circulation and cross various cell membranes including blood placenta and blood brain barriers after ingestion[4]. TiO_2 NPs can be manufactured by using various processes including metal organic chemical vapour deposition, reverse micelles gas phase synthesis, wet chemical synthesis. *Cardiospermum halicacabum* is a woody perennial vine distributed globally in the tropics. It is a fast growing vine up to 10 feet. The herb contains alcohols, phenols, alkynes, flavonoids, alkanes and aliphatic esters are the major phytochemical components present in this plant. The herb also contains terpenoids, flavonoids, tannins, proteins, saponin, glycosides, carbohydrates, volatile esters, and fatty acids[5]. Plant is used for the treatment of rheumatism, abdominal pain, orchitis, dropsy, lumbago, skin diseases, cough, nervous disorders, hyperthermia, anti-viral, anti-ulcer, anti-diabetic, anti-convulsant, antipyretic, anxiolytic, anti-cancer, anti-bacterial, anti-arthritic, anti-fungal, anti-parasitic and fertility activities[6]. Zinc oxide nanoparticles, loaded with *Cardiospermum halicacabum* aerial part extract were synthesized successfully by the chemical reduction method[7]. A detailed characterization of synthesized nanoparticles was carried out using different techniques such as UV visible spectroscopy, Fourier transforms infrared spectroscopy (FT- IR), X-Ray diffraction (XRD), Differential scanning calorimetry (DSC), Thermogravimetry analysis (TGA), Scanning electron microscopy(SEM) [8].

MATERIALS AND METHODS:

Collection of plant material:

The crude drug *Cardiospermum halicacabum was* collected from herbal garden (Moolika Vanam) *aziz nagar*, Hyderabad, Telangana, India. The plant was authenticated by Dr. Rafique, incharge of Moolika Vanam garden.

Preparation of extract:

The collected plant material *Cardiospermum halicacabum* aerial parts were washed twice with tap water and one time with distilled water finally allowed to dry under shade, and then coarsely powdered in a blender. The coarse powder (500 gm) was subjected to maceration for 72 hours, followed by exhaustive maceration for 48 hours by using 99.9% ethanol for *Cardiospermum halicacabum* aerial part. The solvents were decanted and filtered with filter paper and recovered by distillation at 60° C to 70° C. The extract was dried under desiccators[9].

Synthesis of zinc oxide nanoparticles using *cardiospermum halicacabum extract:*

Pure and analytical grade chemicals were used in the synthesis of ZnO nanoparticles such as zinc acetate, ethanol, methanol, distilled water, sodium hydroxide (NaOH). It was prepared by the chemical reduction method. Firstly take zinc acetate 5gm in 250ml of RBF dissolved in 100ml of deionized water and makeup to the 250ml in RBF, then add cardiospermum extract of 20ml into zinc acetate solution at 60^0 c by continuous stirring for 45mins on a magnetic stirrer for complete dissolution. After that kept it under reflux for 24hours at 100 ^{0}c in a water bath. Then add 10ml of NaOH solution (0.1M) drop wise from the corner of the flask with continuously stirring and again the total mixture was kept under reflux for 5hours. centrifugation for 20 minutes then filter the solution by using whatman filter paper. Then dried in an oven at 80^0c overnight and yield the product accurately finally stored the product.

Characterization:

1) Uv-visible spectroscopy:

The zinc oxide nanoparticle was loaded with ***cardiospermum halicacabum extract*** was characterized by UV-3000 series spectroscopy to know the kinetic behavior of the synthesized nanoparticles. The samples were scanned in a range between 200-800 nm.

2) Fourier transform infrared radiation (FT-IR):

FT-IR studies were carried out to detect the functional groups and to observe the interactions of various constituents and functional groups present in the sample. The sample exhibits various vibrational bands at particular peak intensities which can be further interpreted. This technique has been used to obtain an IR spectrum of absorption or emission of the

synthesized nanoparticle.

3) X-ray diffraction studies:

The phase determination of the synthesized nanoparticles, crystalline dimensions, the bulk composition can be studied using X-ray diffraction techniques (BRUKER D8 ADVANCE) using Cu radiation. The synthesized Zinc oxide nanoparticle from zinc acetate samples loaded with ***cardiospermum halicacabum extract*** extract was scanned along with 2θ ranges. The various phase dimensions present in the samples were identified with available data

4) Scanning electron microscopy (SEM):

The morphological characteristics and particle size assessment of synthesized nanoparticles were studied using FFI Quanta 200 FEG with EDS scanning electron microscopy. The samples containing prepared Nanoparticles were diluted using distilled water and sonicated. A small drop of the sample was placed on round cover glass (1.2cm) and allowed to dry in a desiccator at room temperature mounted on an SEM stub and coated with a thin layer of platinum to make the samples conductive for SEM analysis. The compositional analysis was carried using energy-dispersive X-ray spectroscopy [EDS] which identifies the phases present in the samples.

5) Differential scanning calorimetry (DSC):

The thermal properties such as enthalpy, heat flow, decomposition rate profile, melting point, and phase transitions reactions of the sample can be determined by differential scanning calorimetry (DSC)

6) Thermogravimetric analysis (TGA):

To study the Thermal decomposition rate profile of a powered sample and to determine the thermal stability, mass transfer over time and temperature in a sample can be measured by thermal gravimetric analytical techniques. A thermogravimetric analyzer measures mass by varying the temperature over a while.

RESULTS AND DISCUSSION:

1) UV visible spectroscopy:

Table No 1: Concentration Vs Absorbance ZnO Np Loaded With *Cardiospermum halicacabum* Extract.

S.NO.	CONCENTRATION	ABSORBANCE
1.	0.5	0.21
2.	1.0	0.33
3.		0.41
4.	2.0	0.54
5.	2.5	0.68
6.	3.0	0.78

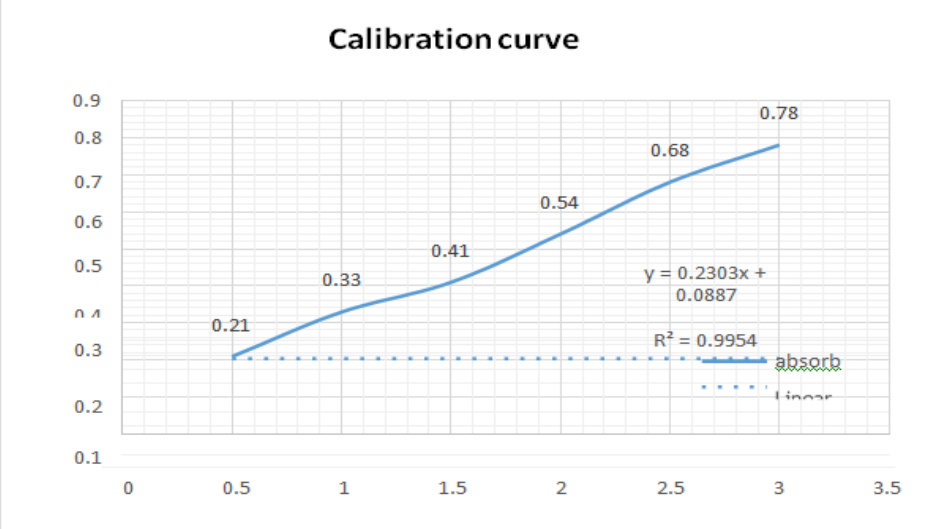

Figure 1: Calibration Curve ZnO Np Loaded With *Cardiospermum halicacabum* Extract.

2) FT-IR spectral analysis of nanoparticles:

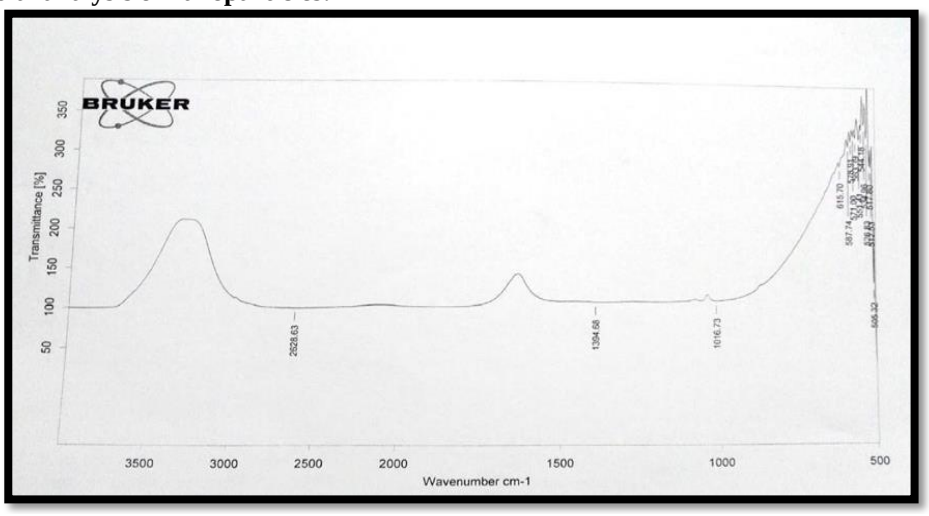

Figure 2: FT-IR spectral peak values and functional groups obtained zinc oxide nanoparticles.

Table no. 2: peak values and functional groups obtained zinc oxide nanoparticles

S.NO	PEAK VALUE	FUNCTIONAL GROUP
1.	2628.63	Aliphatic N-H Stretching
2.	1394.68	Aromatic ring: C-H
3.	1016.73	Aromatic ring: C=C
4.	615.70	Aromatic amine: C-N
5.	587.74	S=O Stretching

3) X-ray diffraction pattern for synthesized Nanoparticles:

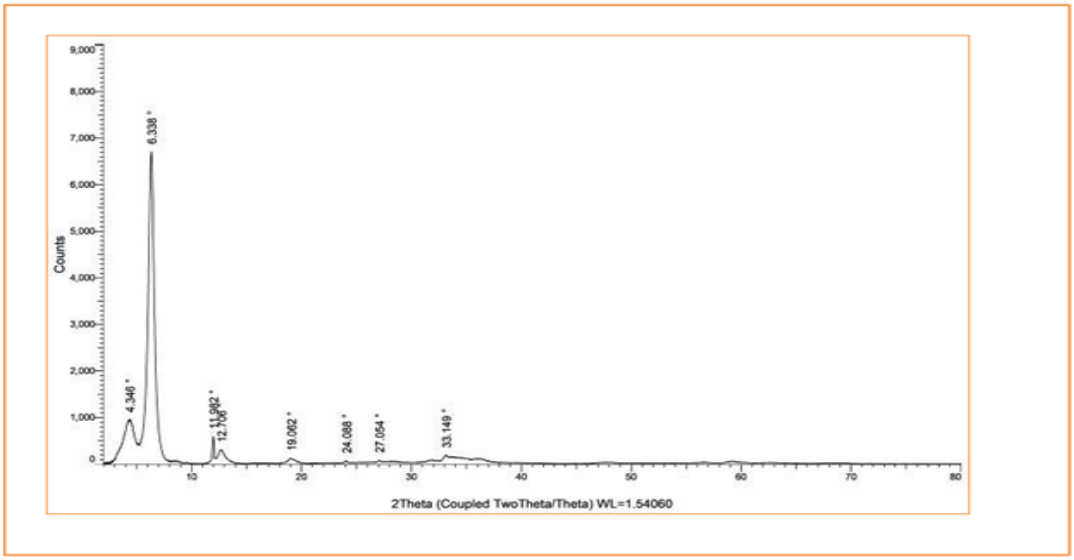

Figure 3 : XRD Graph

Table no. 3: XRD Values for synthesized Nanoparticles

S.No.	Angle	d-value	Relative intensity
1.	4.36^0	20.31	14.2%
2.	6.34^0	13.93	100.0%
3.	11.98^0	7.38	8.8%
4.	12.70^0	6.96	4.6%
5.	19.06^0	4.65	1.9%
6.	24.05^0	3.69	1.1%
7.	27.05^0	3.29	1.2%

4) SEM Analysis for synthesized Nanoparticles:

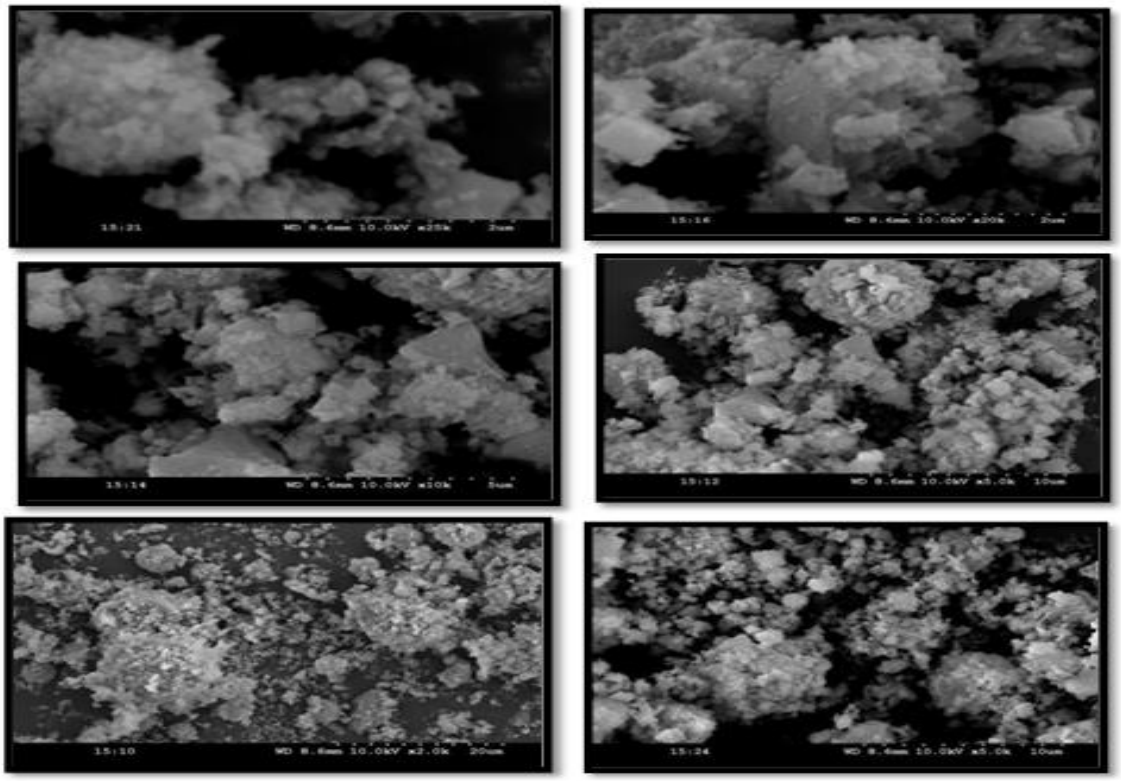

Figure 4: SEM Analysis of ZnO Np Loaded With *Cardiospermum halicacabum* extract.

To acquire the size and to observe the morphology, the synthesized nanoparticle was subjected to scanning electron Microscopical examination (SEM). And the images are presented above. The *Cardiospermum halicacabum* extract concentration will directly influence the size and morphology of nanoparticles. Increased concentration of zinc oxide (1% w/v) covers the thick layer to form a hollow spherical globular.

5) DSC study of nanoparticles:

It was observed that endothermic peak at a temperature ranging from 10 ° C to 130 ° C and the thermogram of zinc oxide shows a broad endothermic peak which may be due to loss of water of crystallization and exothermic reactions shows the decomposition of nanoparticles.

The thermogram of zinc oxide nanoparticles was characterized by a sharp endothermic peak appearing at a temperature range of 132.67^0C, which indicates the melting point [% weight loss] of the drug with a temperature onset at about 130° C is recorded. The enthalpy is normalized at (247.50)15.42j/g.,

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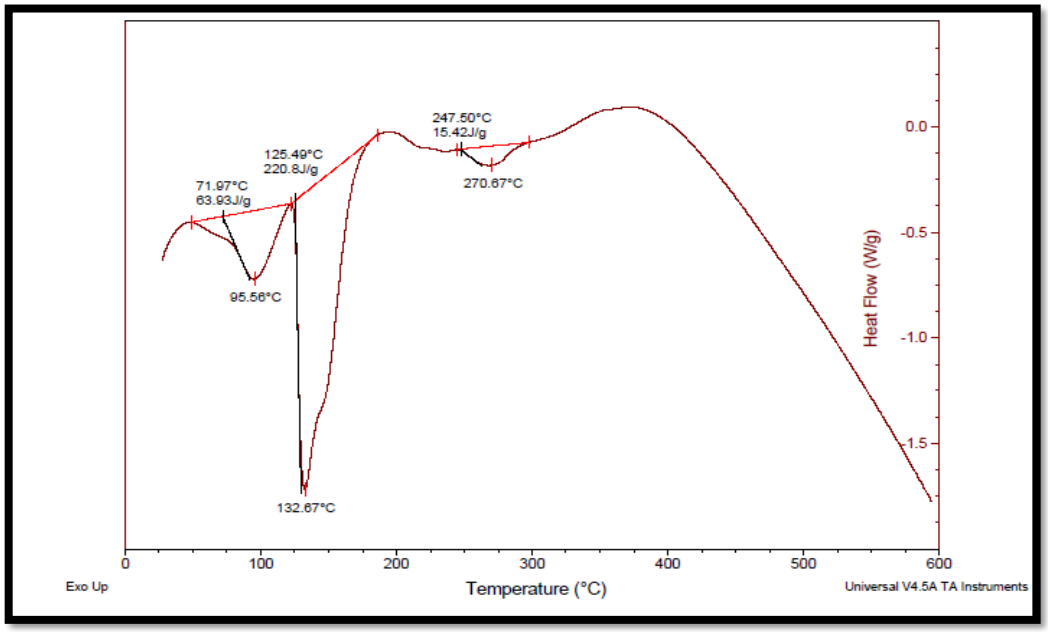

Figure 5: Differential Scanning Calorimetry (DSC)

6) Thermo gravimetry analysis (TGA):

The Thermogravimetric analytical representation, which is a simple and accurate technique to study the decomposition pattern and thermal stability of polymers Thermogravimetric analysis of zinc oxide nanoparticles is carried out under nitrogen atmosphere and the analytical result of the thermogram shows the thermal stability and thermal behavior of *Cardiospermum halicacabum* extracted the nanoparticle by Heating sample from 10 to 900 °C, at 10 °C per minute results in 6.570% mass loss due to polysaccharide.

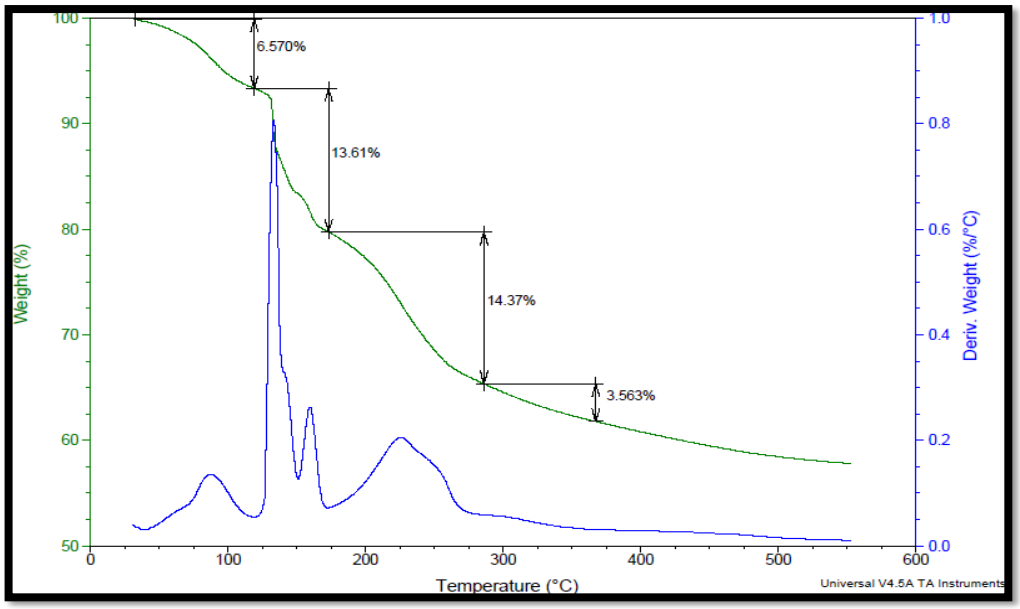

Figure 6: Graphic presentation of TGA

CONCLUSION:

Zinc oxide nanoparticles were loaded with *Cardiospermum halicacabum* extract and were synthesized successfully by the chemical reduction method. Generally, the chemical methods used are too expensive, and incorporate the use is too

expensive. A detailed characterization of synthesized nanoparticles was carried out using different techniques such as UV vis spectroscopy, Fourier transforms infrared spectroscopy (FT- IR), X-Ray diffraction (XRD), Differential scanning calorimetry (DSC), Thermogravimetry analysis (TGA), Scanning electron microscopy (SEM). The future scope of this research work about *Cardiospermum halicacabum* is wide because, it is a natural source with antioxidant activity and used to treat different types of diseases traditionally.

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