

# EFFECTS OF RUTIN AND CAFFEINE ON THE ABSORBABLE SUTURE MATERIALS

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## Abstract

**AIM:** To assess the influence of rutin and caffeine on absorbable sutures.

**INTRODUCTION:** Absorbable sutures are initially equal or superior to non absorbable sutures in terms of tensile strength but are absorbed at variable rates by the action of hydrolysis (1). synthetic absorbable sutures have been recognised as an important step forward in the history of suture materials. Synthetic absorbable sutures have been approved by the Food and Drug Administration for almost all surgical uses with the exception of certain cardiovascular and neurological procedures (2). Many drinks, including coffee and tea, contain a significant amount of the purine alkaloid caffeine. Antioxidant effects of caffeine and its metabolites theobromine and xanthine have been demonstrated.

**MATERIALS AND METHODS:** Two resorbable sutures (PGA and Vicryl) were used for the study. The suture materials were coated with rutin and caffeine and were subjected to Scanning electron microscopy, to assess the tensile strength, antioxidant and anti inflammatory activity.

**RESULTS AND DISCUSSION:** According to the study, PGA had higher tensile strength than vicryl at day 14 and is a good suture if tensile strength is needed after that point. Rutin showed relatively higher antioxidant activity when compared to caffeine. caffeine showed good anti inflammatory activity.

**CONCLUSION:** On analysing the tensile strength, PGA suture shows greater tensile strength compared to vicryl suture.

## INTRODUCTION

Sutures are biomaterials, either natural or artificial, that are utilized to bind blood vessels and adhere tissues together. The objectives of wound closure include eliminating dead space, maintaining tensile strength across the wound until tissue tensile strength is sufficient, and evenly distributing tension along deep suture lines. While absorbable sutures initially have tensile strength that is on par with or better than nonabsorbable sutures, they are absorbed at varying rates due to the action of hydrolysis. (1) The type of tissues involved, the constant presence of saliva, the high tissue vascularization, and processes related to speech, mastication, and swallowing are only a few of the aspects that distinguish suturing in dentistry from suturing in other sections of the body. Relevant sutures must have particular physical traits and qualities, such as good tensile strength, dimensional stability, absence of memory, knot security, and enough flexibility to prevent oral mucosa damage (2). In the history of suture materials, synthetic absorbable sutures have been acknowledged as a significant advancement. The Food and Drug Administration has approved synthetic absorbable sutures for practically all surgical procedures, with certain exceptions for critical cardiovascular and neurological procedures (3).

There is widespread agreement regarding the significance of oxidation in both the human body and food. Cells must have oxidative metabolism in order to survive. The generation of free radicals and other reactive oxygen species, which lead to oxidative alterations, is a side effect of this reliance. There is mounting evidence that these species participate in numerous

typical in vivo regulation systems. Free radicals that are produced in excess can overwhelm defensive enzymes like superoxide dismutase, catalase, and peroxidase and have detrimental and fatal consequences on cells (4). The actions of various antioxidants provide defence mechanisms against the effects of excessive oxidations, and the necessity of measuring antioxidant activity is well known.

An inflammatory cascade might be a better name for inflammation. It is made up of a protracted series of chemical processes and cellular activities that help to restore tissue in a variety of life situations, from the healing of the most serious burn wounds to the restoration of a little skin cut. The inflammatory cascade begins at the cellular and tissue level with dilation of the arterioles and venules, as well as increased blood vessel permeability and blood flow, and is frequently followed by stasis and thrombosis, leukocyte infiltration into the tissue, plasma escape into the tissue, tissue breakdown by proteolytic activity and oxygen free radical formation, necrosis and apoptosis, removal by phagocytic cells, and production of new tissue (5). Inflammation is now considered the pinnacle of human disease research. Anti-inflammatory medications that have been demonstrated to be helpful in treating one condition may also be useful in treating another, providing a larger variety of interventional opportunities.

Flavonols like rutin are widely distributed in plants like apple, buckwheat, tea, and passion flower. It is an essential part of food's nutrition. Buckwheat contains rutin, also known as rutoside, quercetin-3-rutinoside, and sophorin, a citrus flavonoid glycoside. The plant *Ruta graveolens*, which also contains rutin, is where the word "rutin" originates. Chemically, it is a glycoside made up of the disaccharide rutinoside and the flavonolic aglycone quercetin. It has shown a variety of pharmacological effects, including anti-inflammatory, anti-cancer, cytoprotective, vasoprotective, neuroprotective, and cardioprotective effects (6)

Although it has been found in more than 60 plant species, caffeine (1,3,7-trimethylxanthine) is a psychostimulant alkaloid that is naturally present in coffee, tea, cacao beans (the source of chocolate and cocoa), guarana, mate, and kola nuts. Caffeine is currently the psychostimulant that is most often used worldwide. More than 80% of people in the globe and up to 89 percent of people in the United States are said to use caffeine on a regular basis (7,8). Although there is significant inter-individual variation, caffeine is known to generally have dose-dependent effects, with positive or desirable effects at lower doses and unfavorable effects generally above this level of ingestion. Rutin and caffeine are taken as secondary metabolites in food. Hence the present aim of the study is to assess the influence of rutin and caffeine on the absorbable sutures and its antioxidant and anti inflammatory activity.

## MATERIALS AND METHODS:

A total of 2 absorbable sutures PGA and vicryl ( 5 samples each) were used for the study. Each sample were coated with rutin and caffeine and were subjected to SEM analysis, tensile strength and degradation analysis. Extracts of Rutin and caffeine were prepared both individually and as combination and were subjected to assess antioxidant and anti inflammatory activity.

### Preparation of artificial saliva

Artificial saliva was prepared by mixing the following chemicals in one liter of distilled water:

- 1) Sodium azide: 0.75 g
- 2) Potassium monohydrogen phosphate: 0.804 g
- 3) Calcium chloride: 0.166 g
- 4) Magnesium chloride: 0.059 g
- 5) Sodium chloride: 1.02 g

## Tensile strength

The tensile strength of the suture samples was evaluated before, an hour after, and 7 days after immersion. The microtensile tester was used to evaluate the tensile strength of the suture samples at a cross-head speed of 2.0 mm/min. Each specimen was stretched to failure; the maximum load was recorded in Newtons (N) and tabulated for analysis. The point of breakage and the samples were assessed at a magnification 10 using a microscope with an attached digital camera

## SEM

The material was critical-point dried before being mounted in studs with carbon tape for stabilisation and platinum sputter-coated before being examined in a FE-SEM IT800 for SEM processing. At 37 and 120, digital SEM micrographs were collected along the whole length of each suture. This gave a complete view of the debris on the circle of the sutures that was evident in the SEM on one half of the circumference (9)

## Anti-inflammatory activity

The anti-inflammatory activity for rutin and caffeine was tested by the following convention proposed by Muzushima and Kabayashi with specific alterations. 0.05 mL of rutin and caffeine extract of various fixation (10µL,20µL,30µL,40µL,50µL)was added to 0.45 mL bovine serum albumin(1% aqueous solution) and the pH of the mixture was acclimated to 6.3 utilizing a modest quantity of 1N hydrochloric acid. These samples were incubated at room temperature for 20 min and then heated at 55 °C in a water bath for 30 min. The samples were cooled and the absorbance was estimated spectrophotometrically at 660 nm. Diclofenac Sodium was used as the standard. DMSO is utilized as a control.

Percentage of protein denaturation was determined utilizing following equation,

$$\% \text{ inhibition} = \frac{\text{Absorbance of control} - \text{Absorbance of sample} \times 100}{\text{Absorbance of control}}$$

## Antioxidant activity

1, 1-Diphenyl-2-picrylhydrazyl radical scavenging assay is the most widely used method for screening antioxidant activity , since it can accommodate many samples in a short period and detect active ingredients at low concentration . 50% methanol, DPPH solution and the prepared compound was added in 5 test tubes ranging from 10-50 microlitres and it was kept in a dark place for incubation for minutes and the readings were analysed spectrophotometrically.

## RESULTS:

### Antioxidant Activity (DPPH Assay)

Rutin	Caffeine	Rutin- caffeine	Ascorbic acid
73.34	52.28	64.25	89.21

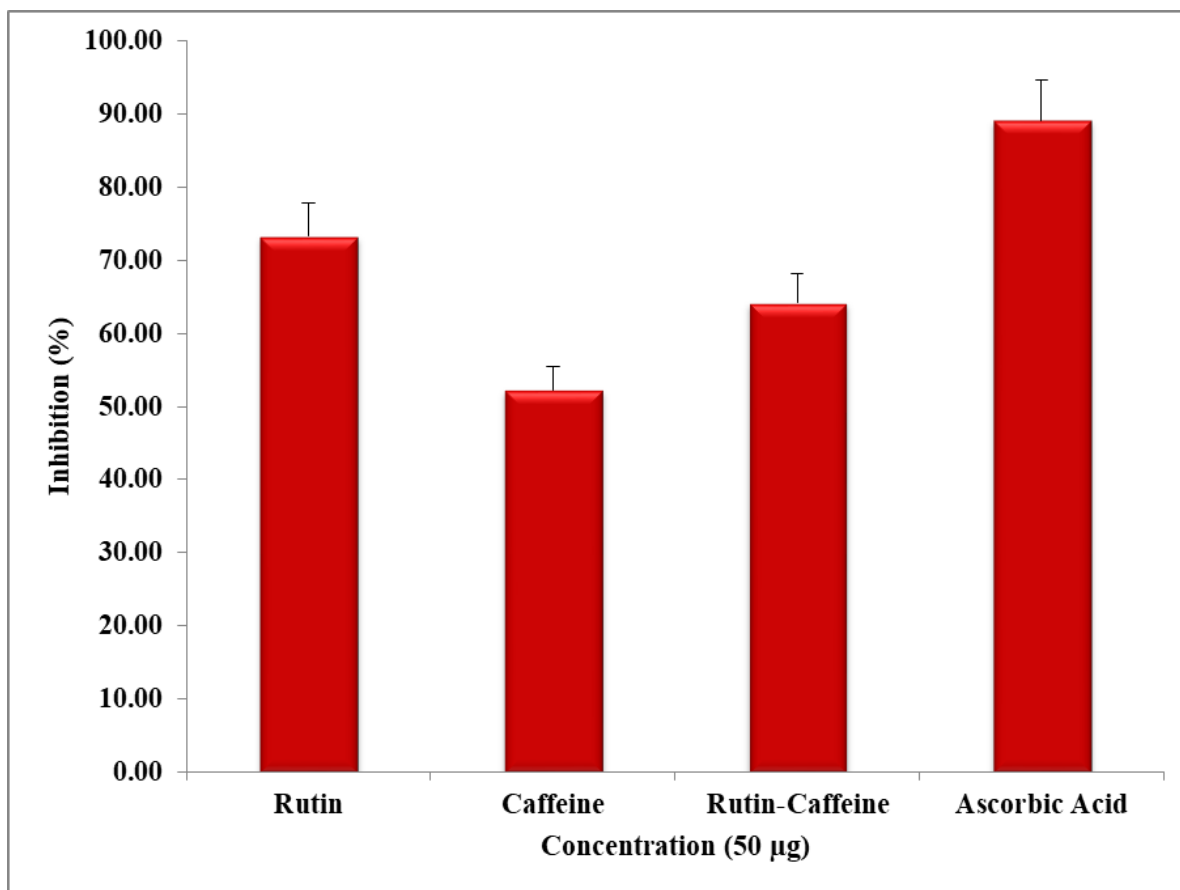


Figure: Graph showing the antioxidant activity of rutin and caffeine through DPPH assay. The sample showed DPPH radical scavenging activity in a concentration-dependent manner. The colour changes are observed at 10µl, 20µl, 30µl, 40µl and 50µl concentrations. The maximum DPPH activity was shown by rutin which was observed to be 70% when compared to standard value (90%). Caffeine showed relatively less activity when compared to rutin.

#### Anti-inflammatory activity

Rutin	Caffeine	Rutin- caffeine	Diclofenac
85.67	94.37	77.47	89.21

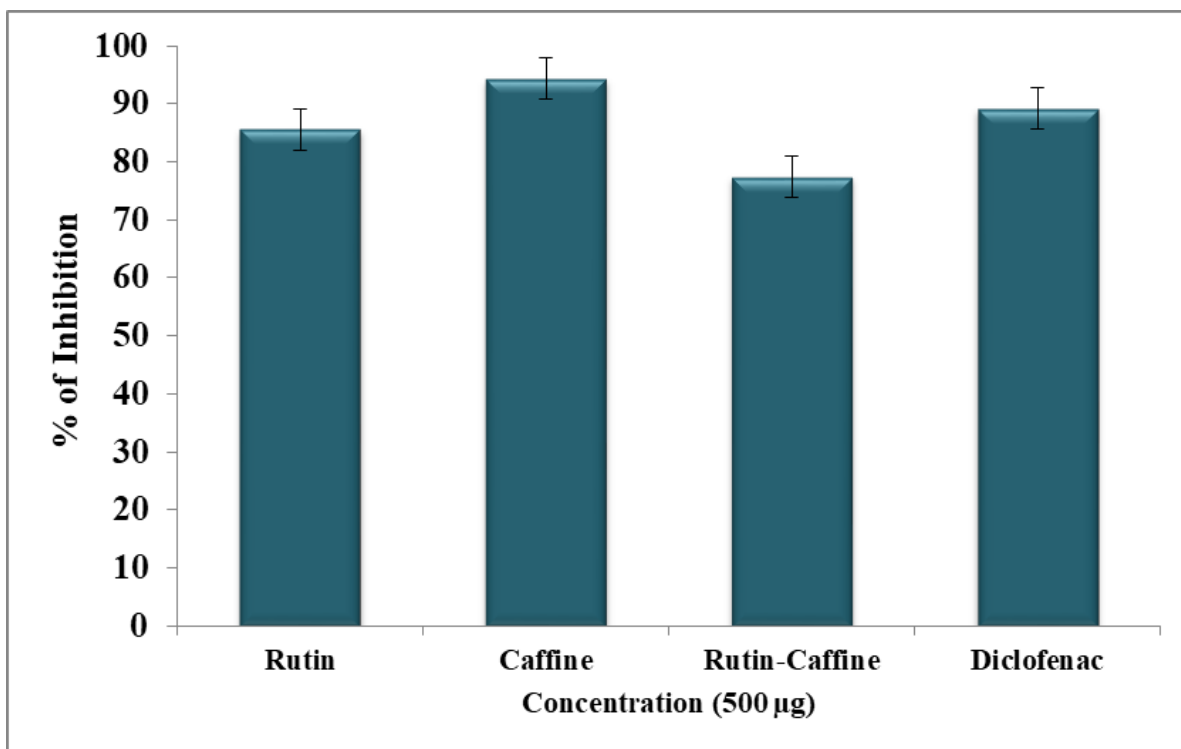
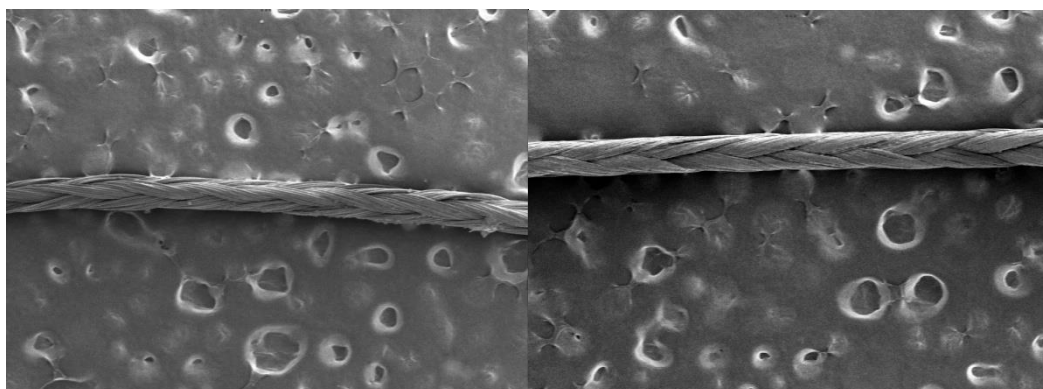
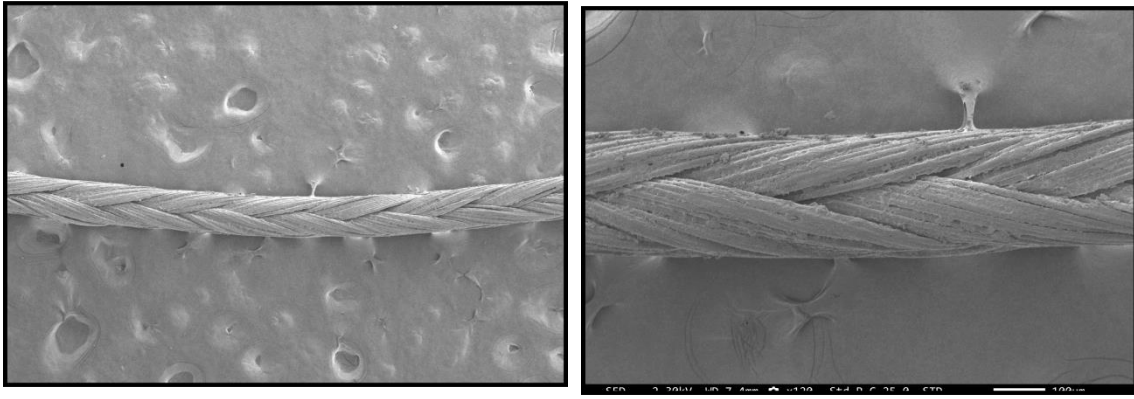


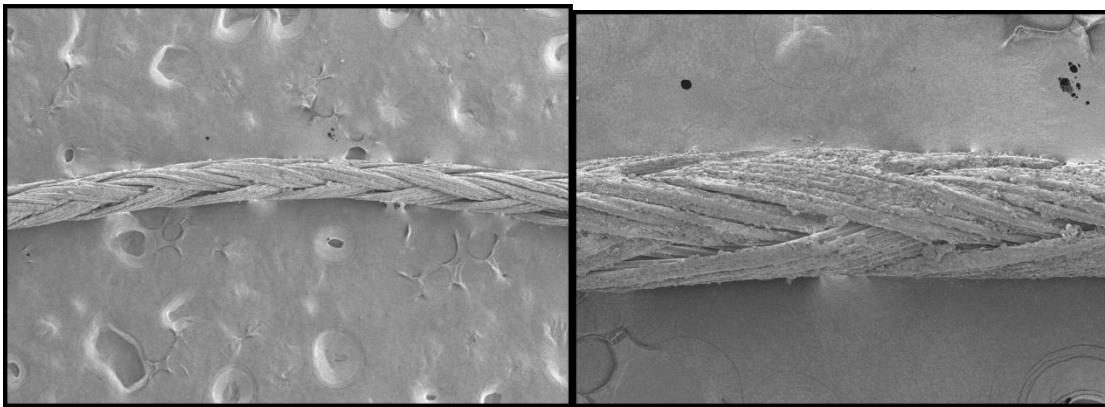
Figure : Graph showing the anti inflammatory activity of rutin and caffeine through albumin denaturation assay. In this assay, bovine serum albumin is used as protein and is compared to the standard anti inflammatory agent (i.e. Diclofenac sodium). It was effective in inhibiting the albumin denaturation at different concentrations. Combined action of rutin and caffeine showed relatively less anti inflammatory activity when compared to individual compounds.



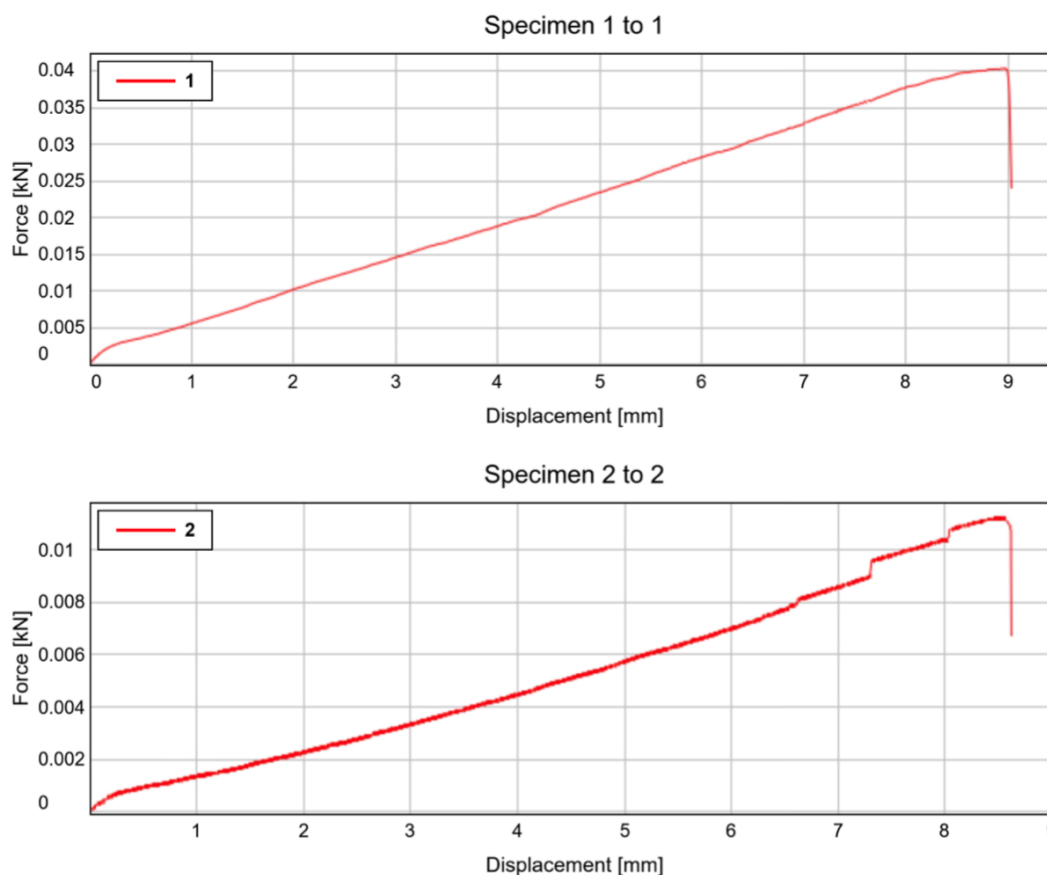
Scanning electron micrograph of control vicryl and pga sutures pre immersion at 37x magnification



Scanning electron micrograph of PGA suture after coating with rutin and caffeine at 37x and 120x magnification showed some debris around the braided suture material when compared to control group.



Scanning electron micrograph of vicryl suture after coating with rutin and caffeine at 37x and 120x showed more irregularities than that of control group as well as coated PGA suture around the braided suture material.



Graph representing the point at which maximum stress a suture material can withstand while being stretched before breaking. The amount of force PGA suture can withstand was found to be 40.41 N and that of vicryl was found to be 11.26 N

	Maximum Force [N]	Tensile stress at Tensile strength [MPa]	Tensile strain (Displacement) at Break (Standard) [%]
1	40.41	6310.31	18.03
2	11.26	1749.50	17.23

	Specimen label	Tensile stress at Break (Standard) [MPa]
1	PGA	5799.71
2	vicryl	1689.90
3	PGA 4.4	8070.71
4	PGA 7.2	6748.40
5	VICRYL 4.4	1459.41
6	VICRYL 7.2	1366.71

Table representing the values at which the suture breaks after being stretched.

## DISCUSSION:

The goal of the current study was to give pertinent information about the bioactivities of caffeine and rutin. PGA suture had a substantially higher tensile strength than Vicryl suture. On day 14, though, the tensile strength of both gauges was extremely low. Additionally, after being submerged in the solution for the first 24 hours, both PGA and vicryl samples kept their initial levels of tensile strength. The tensile strength of PGA suture pre immersion was found to be  $26.9 \pm 2.33$  N whereas after immersion with rutin and caffeine showed tensile strength of 40.41 N . This shows that the tensile strength is increased after coating.

In order to provide temporary and mechanical support while the natural tissue heals and regains strength, synthetic absorbable sutures all have the same prescription. The degradable suture gradually deteriorates as the natural tissue recovers, causing a gradual stress transfer. Therefore, a significant problem in creating a temporary support is regulating the pace of degradation of an absorbable suture to facilitate appropriate healing of the surrounding tissue. Clinically, the majority of absorbable sutures are made of biodegradable linear aliphatic polyesters, the most significant of which is PGA because it is the source of the majority of other biodegradable polymers (10). PGA sutures had excellent handling characteristics, strong initial tensile strength, and minimal tissue reactivity in previous studies (11). In that it doesn't cause much tissue reaction and has more tensile strength than other materials with a similar diameter, PGA suture has some features superior to those of other materials.

According to the study, PGA had higher tensile strength than vicryl at day 14 and is a good suture if tensile strength is needed after that point. Suture selection in the oral cavity should be based on the needs of the repair and the surgeon's preference, even though the results of this in vitro investigation recommend the use of synthetic absorbable sutures.

The choice of material for internal use in deeper layers and for skin approximation depends on how a suture degrades. Typically, absorbable sutures are made of synthetic polymers that go through hydrolysis or mammalian collagen, which is eventually destroyed by body enzymes. The degree of degradation is higher in case of vicryl suture after coating whereas it is lower in case of PGA suture.

## CONCLUSION:

Caffeine has a comparatively low free radical scavenging activity and has a high anti inflammatory activity compared to its standard agent. Rutin can be a potential anti inflammatory as well as antioxidant agent. On analysing the tensile strength, PGA suture shows greater tensile strength compared to vicryl suture. Rutin and caffeine eventually increased the tensile strength of PGA suture. Hence the intake of rutin and caffeine as secondary metabolites

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## CONFLICT OF INTEREST:

There is no conflict of interest

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