

A short review of the use of 'keshi' as a term to describe pearls

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Abstract: The original term 'keshi' describes tiny mantle pearls that developed without a tissue transplant during the production of Akoya cultured pearls. The term is now often used for gonad-grown cultured pearls that have formed from mantle tissue grafts under conditions where a bead has been rejected. A discussion of the term 'keshi' in its original and recent application is given. The formation of original and recent keshi cultured pearls is explained, with radiographs and cross sections of recent keshis. Current pearl trade use of the term is discussed. An alternative term to keshi – a beadless cultured pearl – is proposed. Recent Chinese freshwater cultured pearls with beads and the potential increase in numbers of beadless cultured pearls are discussed.

Keywords: beadless cultured pearls, bead rejection, Keshi cultured pearl, Keshi pearls

Introduction

In earlier gemmological literature the term 'keshi' was traditionally used for small, near-round nacreous pearls deriving from Akoya shells that have undergone operations for producing beaded cultured pearls (Henn, 2001; Strack, 2001). The keshi pearls are characterised as unexpected by-products or even natural pearls (Webster, 1983, p. 538) and enjoy thus a close-to-natural identity. In the CIBJO nomenclature rules (CIBJO, 1998), the term 'keshi' appears under cultured pearls. We have noted that over approximately the last ten years, the term 'keshi' has increasingly often been used for pearls which do not come from the Akoya oyster (Figure 1) and are significantly larger. In fact today the name keshi pearl is applied to a great number of large, well-shaped to off-shaped South Sea and Tahiti cultured pearls. This article reviews the background of



Figure 1: Beadless cultured Tahiti pearl – a so-called keshi – mounted as a pendant, with its radiograph showing a large irregular cavity (dark area). Length of the pearl 22 mm. Photo © H.A.Hänni, SSEF.

this new application of an old term to recent production of cultured pearls and discusses gemmological terminology and trade usage.

Comments on how Japanese keshis formed

An early description of the term 'keshi' in the western gemmological literature can be found in Taburiaux (1983, 1985). Keshi pearls have been found sporadically in Japanese Akoya shells during harvesting the beaded cultured pearls, and they are usually around 2 mm or smaller (*Figure 2*).



Figure 2: Keshi pearls from Japanese Akoya production. The smaller ones are mantle pearls which grew as a reaction to damage at the edge of the shell and in the mantle epithelium incurred during handling. The small size is consistent with the short period of time between the operation and the harvesting. The oblong and bigger ones are gonad grown, as a consequence of a lost bead. Length of the gauge is 1 cm. Photo © H.A.Hänni, SSEF.

It is interesting that these original keshi pearls were found in the mantle tissue, and not in the gonads that had received the mantle tissue transplant. They therefore cannot owe their formation directly to the transplanted epithelium. That they are always small has to be related to the age of the shell, or more correctly, with the length of time between the handling of the shells and harvesting of the crop. The following thoughts are deduced from the author's own observations and reflections and are

presented without having consulted the extensive professional literature in Japanese; should any of the ideas be similar, apologies are offered.

The formation of a natural pearl is in most cases the consequence of an injury to the external mantle tissue (Gübelin, 1946; Hänni, 2002). The subsequent healing of that injury may lead to the formation of a cyst, i.e. a pearl sac lined with external mantle tissue. Further production of calcium carbonate leads to the concretion, which may consist of or be coated with nacre, i.e. the pearl. Very small natural pearls are sometimes called poppy seed pearls (Landmann *et al.*, 2001, p 61). They are in fact the natural counterpart to the original keshis in *Pinctada martensii*, the classical Japanese oyster for beaded cultured pearls.

To explain a keshi pearl in the mantle, we should therefore look for an injury which dates back a sufficient number of years to account for the size of the small pearl encountered at the harvest of the Akoya cultured pearls. Since the growth period for Akoya cultured pearls is approximately one year to get a relatively thin nacre overgrowth on the bead, we can thus assume that the injury occurred during the handling of the shells from the sea to the operation table and back again to the sea. The very thin and fragile edge of the shell may have received a blow or have been damaged. The subsequent healing of such involuntary damage may well be the start of what is to become the so-called keshi pearl. In the short time between the operation (when the injury happened) and the harvest, a 2 mm pearl is perfectly well imaginable. When the keshis are retrieved from the shells during harvesting of the Akoyas, other concretions are also collected that have grown from tissue grafts that have accidentally lost the bead (*Figure 2*). Such formations include gonad-grown concretions that occur from tissue grafts that have lost the bead. They are small, randomly shaped, beadless cultured pearls, also of a size consistent with the short period of growth allowed for the Akoya process (i.e. operating on a mature *Pinctada martensii* oyster to produce beaded cultured pearls and harvesting them after a few months).

Requirements for the formation of a cultured pearl

Over about the past hundred years, the growth of (cultured) pearls that do not adhere to the shell has been stimulated by the transfer of a small piece of mantle tissue (mantle epithelium) from a sacrificed donor oyster into the body of a living oyster. The sites in the body where the grafts of tissue are most successful are the mantle or the gonad (the reproductive organ). The mantle tissue is the organ which lines and builds the shells, while the gonad is situated deep in the shell. To carry out the operation, the living oyster shell is opened about one centimetre and the tissue transplant is inserted with or without a bead.

In order to produce a cultured pearl, a small number of technical conditions must be selected (some of these options are independent from each other):

- one may work with freshwater or seawater oysters
- the cultured pearl may grow in the mantle or in the gonad, i.e. the tissue can be transplanted into the mantle or into the gonad
- the cultured pearl may or may not have a bead
- the donor oyster and receiver oyster may or may not be of the same species.

Should one decide to have mantle-grown cultured pearls, the first operation would include only the tissue transplant – the young oysters have a mantle that is too thin to house a bead – and their first (or only) product will be a beadless CP. With time both the pearl sacs and the shell rim grow larger so that the CPs virtually slide into the shell.

Should one decide to have gonad-grown cultured pearls, one has the choice to add a bead (beading) to the mantle tissue transplant (grafting). To start the formation of a CP, the grafting is indispensable but the beading is optional. In many circumstances, using one or both of these terms presents a much clearer picture than using the term ‘nucleation’ where either could be meant.

Understanding the formation of the product

Over the past several years large pearls that carry the name keshi have become more common in trade fairs, in advertisements and in jewellery shops. They come mainly from cultured pearl (CP) farms using *Pinctada maxima* and *Pinctada margaritifera* shells, i.e. from salt-water oysters. Although the formation of small by-products in these shells, as in the Japanese Akoya, is possible, these so-called keshis differ in size and mostly also in shape from the original. Commonly these large keshis are found in the gonad tissue, and not in the mantle of the shell (Clinton Schenberg, *pers. comm.*, 1998; Dora Fourcade, *pers. comm.* 2003; Andy Müller, *pers. comm.*, 2005).

Keshi pearls from Australia, Tahiti or from the Philippines, are completely different from the keshi pearls as found in the Akoya oyster. Through the study of X-ray pictures of such so-called keshi pearls we can distinguish two types among them. Type 1 has a growth characteristic which is very similar to that of a beadless CP, such as the freshwater CPs from China. The shape is round to oval and a trace of a relatively small cavity is visible in the centre (Hänni, 2002). Most type 2 pearls have a flattened baroque shape with a distinct central cavity visible on the X-ray picture. The similar appearance of the central cavities in pearls of both types to central cavities in beadless freshwater CPs offers an explanation for their formation. The following comments are based on our observations and follow discussions with cultured pearl specialists D. Fourcade in 2003, A. Müller in 2002 and C. Schenberg in 1998.

Type 1: In the course of the production of beaded cultured pearls, it may happen that the oyster rejects the bead nucleus, although the tissue transplant is already grafted into the gonads. The mantle tissue will thus form a pearl sac and secrete calcium carbonate from its inner surface, and in this way produce a beadless cultured pearl. Because the piece of mantle tissue was placed into the gonad, this cultured pearl will grow in the gonad and later be harvested from there. Such formations are well known from all oysters that are commonly used for bead-cultured pearl production such as *Pinctada maxima* and *Pinctada margaritifera* (South Sea and Tahiti) (Figure 3).



Figure 3: South Sea *Pinctada maxima* (left) and Tahiti *Pinctada margaritifera* (right) beadless cultured pearls as grown after rejection of the bead after the first operation (tissue transplant and bead implant). Largest pearl is about 8 mm long. Photo © H.A.Hänni, SSEF.

Type 2: After a first CP with bead is harvested from one of the above-mentioned shells the already-present pearl sac is ready to take a second bead (second nucleation). Such a second bead nucleus is of the size of the previously harvested pearl and is placed in its former position. Since the inner surface of the pearl sac is still productive and will continue to precipitate nacre, the second bead will soon be covered with an overgrowth. There is thus no need for a second grafting or tissue transplant. Often, however, the bead is rejected from the pearl sac immediately after its introduction. The pearl sac then collapses since it is unsupported by a bead, but on its surface nacre is still being produced, forming a flattened to baroque shaped beadless CP. After the normal growth period, this product is harvested with the other CPs of the 'second generation' (Figure 4).

We can assume that beadless CPs may be formed in the gonads of operated shells when the first or second introduction of a bead is unsuccessful. In both situations, the formation is caused by the mantle tissue formerly transplanted (grafted) into the gonads. In a cross section through beadless CPs from saltwater oysters the structure is clearly visible. In type 1 the central cavity is small and more equidistant from the pearl's surface. In type 2 the surface continues to precipitate calcium carbonate, forming a



Figure 4: South Sea *Pinctada maxima* (left) and Tahiti *Pinctada margaritifera* (right) beadless cultured pearls as grown after rejection of the second bead (after collection of first cultured pearl and second bead implant). Larger pearl is about 15 mm long and 4.5 mm thick. Photo © H.A.Hänni, SSEF.



Figure 5: Cross sections through four beadless South Sea cultured pearls. The pearl at the upper left is from a first crop (after rejection of the first bead) and the other three pearls are from a second crop (after rejection of the second bead) where larger pearl sacs had collapsed. Length of the pearl on the lower left is 18 mm. Photo © H.A.Hänni, SSEF.

crust around a collapsed sac and leaving an irregular and perhaps large gap in the centre, as seen in *Figure 5*. In *Table I* the different beadless cultured pearls and their origin and trade terminology are listed.

Identification of beadless cultured pearls

The identification of beadless cultured pearls is most readily done with X-ray shadow pictures, i.e. radiographs. The method is described in a number of books and professional papers (e.g. Hänni, 1997; Scarratt *et al.*, 2000). However, distinction of natural pearls from beadless cultured pearls

is not always easy. Usually the beadless cultured pearls are characterised by a mark on the radiograph indicating a relatively significant central cavity and a number of growth bands with slight undulations. Those beadless cultured pearls that are currently called ‘keshi’ (*Figure 4*) show quite significant central cavities as seen in the X-ray pictures in *Figure 6*. Beadless cultured pearls do not reveal the directional characteristics shown by CPs with nacre beads, so the Laue diffraction method (Hänni, 1983) is not useful. A separation between saltwater and freshwater beadless cultured pearls can be done by X-ray luminescence on the basis of the Mn content (Hänni *et al.*, 2005).

Table I: Identification and trade terms for beadless cultured pearls.

Shell type	Trade name	Identification
<i>Pinctada martensii</i> (Akoya)	keshi	beadless cultured pearl
<i>Pinctada maxima</i>	South Sea keshi	beadless cultured pearl
<i>Pinctada margaritifera</i>	Tahiti keshi	beadless cultured pearl
<i>Cristaria plicata</i>	freshwater pearl	beadless cultured pearl
<i>Hyriopsis cumingi</i>	freshwater pearl	beadless cultured pearl

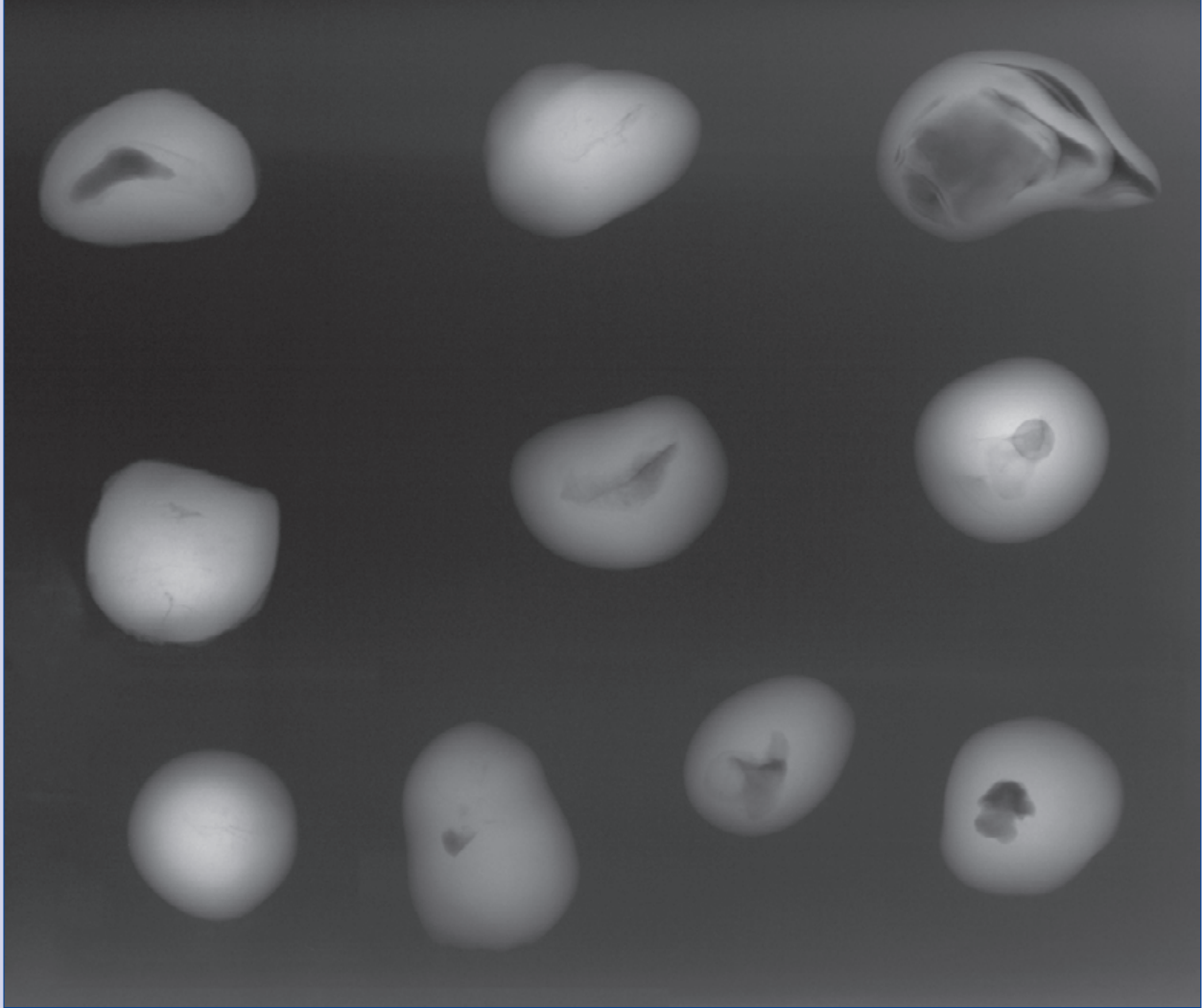


Figure 6: X-radiograph of a number of beadless South Sea cultured pearls called 'keshi' in the trade. Central cavities are visible in most pearls and show typical appearance. Photo © H.A.Hänni, SSEF.

Discussion of the recent use of the term 'keshi'

We have seen that the original application of the term 'keshi' is related to an injured rim of the shell in the mantle area. Original keshi pearls are thus 'mantle pearls', and not 'gonad pearls'. The more recent application of the term 'keshi' is related to concretions caused by mantle tissue transplants (grafts) into the gonads. However, the feeling in the pearl trade has always been more favourable to the term 'keshi' as such pearls were considered somehow to be more natural than straight cultured pearls. Such feeling and pressure from pearl traders led to the International Confederation of Jewellery, Silverware, Diamonds, Pearls and Gemstones (CIBJO) agreeing to the term 'keshi' for use in describing a seawater cultured pearl without

a nucleus (CIBJO, 1999). Descriptions in popular text books on pearls may introduce the same meaning of the expression that "something went wrong in the process of culturing pearl" (Matlins, 1999). In the same book it is made clear that the keshi is considered "not a natural pearl".

Although those in the pearl trade may call the 'gonad pearls' keshis, it is very questionable if it is scientifically helpful to equate these with the accidentally produced original keshi pearls. Their position in the gonads, the use of voluntarily grafted mantle tissue and their size are three major features of difference. So, while the keshis may strictly be by-products, since the producer wanted a fully round large beaded pearl rather than a baroque one, they cannot be considered as natural accidents since the tissue was transplanted into the gonads voluntarily. These 'gonad pearls' are

definitely cultured pearls since they derive from the tissue transplant. The author thinks that the terms 'beadless cultured pearl' or 'baroque beadless cultured pearl' would be acceptable names, which is furthermore correct in its statement, and that such pearls should not be called keshi pearls.

There is considerable danger in widening the term 'keshi' to include beadless CPs. Chinese production now consists largely of beadless (freshwater) CPs. Would the Tahiti and South Sea cultured pearl producers want the Chinese producers to market their pearls as keshis, merely because they are beadless? In one sense, the Chinese producers could even argue that their products grow in the mantle, just as the original keshis do. With the forthcoming production of beaded freshwater CPs from freshwater shells in China, we must also expect greater numbers of beadless CPs after bead rejection. The new production of large beaded CPs from the Chinese mussels is achieved by introducing a bead after the harvest of the first large beadless pearl (*Figure 7*). By this process the mussels can produce a second CP after only a short time, but one which is beaded. Since the mantle production of CPs can yield over 40 pearls in one mussel, intentionally flat beadless CPs can be produced simply by not inserting a bead into the empty pearl sacs. And inevitably, the number of flat beadless CPs resulting from rejection of the bead will also rise (*Figure 8*).

While studying a catalogue from a jewellery auction in Geneva in 1989, the author noticed the term 'keshi' in the description for a seven-strand pearl necklace, although an accompanying gemmological test report identified the pearls as natural. It seems that the cataloguer had chosen the term 'keshi' to refer to the slightly baroque shape of the pearls. So, although the term was used a long time ago, in this context it is potentially misleading; with this article the author would like to restore a clear meaning to the term 'keshi' so that trade and consumers do know what they can expect when it is applied.



Figure 7: Round freshwater beaded cultured pearls from China. These are grown as a second product in the mantle after the first (beadless) pearl has been collected. By inserting a bead into the pearl sac, a second large and round CP can be harvested shortly after the first crop. Photo © H.A. Hänni, SSEF.



Figure 8: The flat beadless freshwater cultured pearls. They represent pearls that have grown as a second product in the mantle after the first (beadless) pearl has been collected. Any bead that may have been inserted has been rejected, so there is no support for the pearl sac and it collapses into a flattened shape, which in turn leads to the flattened pearls. Photo © H. A. Hänni, SSEF.

Conclusion

The term 'keshi' as applied originally to small mantle pearls from the Japanese Akoya cultured pearl production is now used widely for cultured pearls from Tahiti and the South Seas. While the original product can be considered as an unintended by-product,

the pearls that are called keshi today in the market are large beadless cultured pearls. They are produced in the gonad and most are formed after a bead has been expelled after an unsuccessful implant. Although the term is approved in the trade, it is questionable whether these pearls should be named keshis. A term such as 'beadless cultured pearls' would explain more precisely what they really are.

Acknowledgements

The author is grateful to all those who have donated research material for the SSEF pearl research including Dora Fourcade (Pacific Perles, Papeete), Mrs M. Düby (Basel), Nick Paspaley (Darwin), Prof. Xinqiang Yuan (Wuhan), P. Fischer (Golay, Lausanne), T. Frieden (Thun) and Hans Schöffel (Stuttgart). My thanks go also to Dr M. S. Krzemnicki for his draft reading and thorough discussion of the present paper.

Editor's note: The nomenclatures surrounding gem materials are continuously being discussed and updated by CIBJO and other organisations. We believe it important to encourage debate and comment in this Journal, but the views expressed are those of the author concerned.

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